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EARLY WORK AND WORKERS IN AMERICAN HEMIPTEROLOGY.

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Although isolated species of American Hemiptera had been previously described by Linnaeus and others, the real beginning upon the American fauna must be considered as dating from the work of the Danish entomologist, Fabricius, a student under Linnaeus, appearing in the "Systema Entomologia" (1775) and later collected and amplified with many additional species into the "Systema Rhyngotorum" (1803).

The Fabrician species, numerous as they are, and mostly described in the briefest terms are, nevertheless, usually placed with a high degree of certainty, a fact which is in some cases due to the efforts of Stål presented in the "Hemiptera Fabriciana" (1868–9), in which location of type material is indicated. His reference to "America Septentrionale" and "America Meridionale," of very frequent occurrence, though very indefinite according to present standards, may usually be defined for different species.

The next great advance after Fabricius came with that father of American descriptive entomology, Thomas Say, who in addition to his classic Heteropterous Hemiptera (1832) published, in earlier papers, a great number of descriptions of both Homoptera and Heteroptera. These descriptions, considering the time of their writing (1817–1834), the fact that in many instances no related forms were known for comparison, and no standard set for the group, must be considered as models. While usually short, scarcely ever exceeding a third or half a page in length, they almost invariably succeed in depicting those characters which have specific value and it seldom happens that one is in doubt as to the application of the

description to any particular form. Altogether I figure that Say described 168 species of Heteroptera and 65 of Homoptera, a total of 233 and of these 210 are recognized as good species. A high tribute to his care in examining the European literature for existing descriptions as well as evidence of the virgin field in which he worked.

Two German entomologists, Burmeister (1839) and Germar (1839) in their work on Hemiptera included descriptions of numerous American species and genera and their names appear very frequently in our systematic papers.

Harris contributed in this field not only descriptions of a number of species, but many facts of life history worked out in the admirable manner characteristic of all his work. His studies of 17-year Cicada, Vine Hoppers, Membracids and Chinch Bug have become classics and models for later workers, while many of his specific descriptions are now accepted as covering valid species.

In the work of Amyot and Serville, *Hemipteres*, (1843) there are many references to American species, the greater number perhaps, referring to South American species. A number of North American species also were described by Serville and his connection with our fauna is recognized in the name Servillei applied to a species of Acanalonia.

Fairmaire's Revue de la Tribe des Membracides, published in the Annales de la Societe Entomologique de France (1845), includes a number of American species.

Dr. Asa Fitch began his publications on Hemiptera in 1851 and his descriptions, though often inadequate, cover a long list of species and include some of the most important of American insect pests. Aphids, Membracids, Psyllids and Jassids are among the families in which he did his most important systematic work. If we recall that he was a practicing physician, and his entomological work for many years incidental to his vocation, we can appreciate more fully his service to entomology. The descriptions of Membracidae in the Natural History of New York (1854) appearing under the name of Emmons, who was a co-worker and whose descriptions are, by some writers, credited to Fitch, must have been with his assistance or collaboration.

The work of Townsend Glover, though including many references to Hemiptera, was not of special value particularly from the taxonomic standpoint.

The List of Specimens of Hemipterous Insects in the British Museum (1851) includes many descriptions of American species by W. S. Dallas.

Walker's descriptions of Hemiptera (1852–1858) like those in other groups, have been a most grievous trial to American students and pilgrimages to the British Museum to see what "Walker's types" are like are perhaps as profitable here as elsewhere. I can testify, however, that in some instances the descriptions (by some credited to another author) are quite satisfactory and fairly represent the species in hand.

To Carolus Stål, a Swedish naturalist of unusual ability, the students of American Hemiptera owe a deep and lasting obligation. His *Hemiptera Mexicana*, *Membraciden*, *Reduviden* and particularly the *Hemiptera Fabriciana* and *Enumeratio Hemipterorum* are among the first desiderata in the Hemipterist's working library. Many of his South American species described in the Eugenies Resa and the Rio Janeiro Hemiptera occur also in North America and some of them are among our abundant species. Another Swedish entomologist, and a successor to Stål, Spangberg, is to be credited with extensive additions to American Hemipterology, his most important papers being those describing species of Gypona and Jassus (1878).

Along with other groups a number of Homoptera (1861) were described by Benj. D. Walsh. The loss of his types in the Chicago fire in 1879 was, for Homoptera, somewhat akin to the tragic death of the author. Walsh's concept of genera and his descriptions of Homoptera, while sometimes indefinite, are generally found to be fairly well grounded and available in present taxonomy.

One of the most assiduous students of American Hemiptera was Dr. P. R. Uhler and probably to him more than to any other one man we owe the foundation work for our knowledge of the group. His activity in Hemipterology extended over a long period, from 1859 to 1904, and his bibliography (by Henshaw) of fifty-two titles to which two may be added, indicates his industry and service. A list of his separate papers would in itself constitute a paper and present a considerable history of American literature on the group. We may note especially his "Hemiptera West of the Mississippi River," the "Monographs of Cydnidae and Saldidae," the article "Hemiptera," in the Standard Natural History, "Check List of Hemiptera Heteroptera," along with numerous descriptive

papers on species collected in western states and territories by the government surveys and exploring parties. His descriptions are exhaustive and while sometimes apparently too minutely detailed to furnish a quick recognition of species, their application to the details are so accurately stated that, if one has the proper form in hand, he can scarcely have a shadow of doubt as to his determination. His work has covered nearly every family of the order, but his published papers include very little in Aphididae, Psyllidae, Coccidae or Aleurodidae. The families specially indebted to his efforts are Cydnidae, Saldidae, Capsidae, (Miridae) Cicadidae, Fulgoridae, and Jassidae, (Cicadellidae). He was an ardent collector as well as student and hosts of his new species were the result of his own energetic scouring of the localities where he had lived or traveled. The writer can testify to his unselfish aid to students entering this field and he remembers vividly his first visit to the Uhler home in 1882 and the hearty welcome to both the examination of collections and the fireside warmth and hospitality. He was most generous in identifying specimens for others and his service in this direction must be accorded full recognition.

Victor Signoret's contributions to American hemipterology must be given high rank, for while his important memoirs, particularly in the "Tettigonides" (1854–5) and the "Essai sur les Jassidae" (1878) and "Essai sur les Cochenilles" (1869–1874) cover the world, they include so many descriptions of American species and are so necessary in determining genera that they must be at hand for every student of our Hemipterous fauna. Signoret lived in Paris and most of his papers appeared in the "Annals de la Societe Entomologique de France," but his collection, including types of Homoptera, is said to be placed in the museum of the University of Naples, a bit of information that, unfortunately, did not come to me until some years after my winter in Naples, when I would have had time to examine it with care. Of special interest to American students are his papers on Cydnides (1881) and the *Essai sur les Cochenilles* (1869–74) and *Essai sur les Jassides* (1878).

The Abbe Provancher, working in Quebec, Canada, published quite fully on the Hemiptera, and many of our well known species have his name as their authority. His work published in French and mainly in the Naturaliste Canadienne (1872) and Petite Faune de Canada (1885–90), must be consulted for the recognition of species of the Canadian region.

Thomas' "Monograph of Aphididae" (1879) marked a decided step in the study of this family, for, by bringing together all earlier descriptions and describing many others, it became possible to refer readily to the literature of the group. In later life he devoted his time to Ethnology.

The work by Riley, Pergande and Monell, in this same group (Aphididae), deserves also more than passing notice for dealing particularly with the life histories, they disclosed such an unending series of remarkable habits that many others were inspired to follow in their footsteps. The elucidation of the life history of Phylloxera, of Phorodon and of Aphis gossypi are in themselves sufficient to evidence this point.

Oestlund, Forbes, C. M. Weed and others have added in this family to such an extent that another monograph is now a desideratum. Patch, Baker, Gillette, Palmer, Davis, Wilson, Mason, and others have been carrying forward in this field.

Comstock's work on the Coccidae (1880 and 1883) gave the impulse to American study in this family and his admirable papers have been the main foundation on which later students have built, though we must not forget the magnificent work of Signoret. Pergande also should be credited with work in this group, though little appeared in print under his name.

J. Duncan Putnam's Biological study of Pulvinaria and Aspidiotus ancylus is an example of what this talented naturalist would doubtless have done in this group had not his career been cut short on the threshold of life. Mrs. Fernald's monumental catalogue of Coccidae (1903) must be ranked as one of the outstanding contributions in this field. Cockerell, Marlatt, Sanders, Ferris, MacGillivray and Morrison have been active workers in this family.

W. H. Ashmead, during his earlier years, contributed a number of papers on Hemiptera and was an enthusiastic collector in the group. His name appears as the discoverer of the widely distributed *Peregrinus maidis*, which figures extensively in economic literature.

A. E. Schwartz did considerable work, especially on the Psyllidae, and his extensive collecting added much to the known distribution in other groups.

Otto Heideman, for many years the curator in charge of the collections of Hemiptera in the National Museum, was particularly interested in Lygaeidae, Tingitidae and Aradidae

and published a number of valuable papers in these as well as other groups, mainly in Proc. Entom. Soc. Washington.

C. F. Baker, co-author with Gillette of the *Hemiptera of Colorado* (1895), was a remarkable collector and while his later years were devoted to Philippine Hemiptera, his papers on American species cover the period from 1895 to 1906.

Bergroth, the Finnish Hemipterist, whose residence in the United States from 1906 to 1911 gave him an excellent opportunity to study our fauna, contributed many articles especially on the Aradidae and other Heteroptera.

Another famous Finlander, O. M. Reuter, must be credited with a long list of papers dealing with American Hemiptera, perhaps his most important contributions being in the family Miridae, a group which our brilliant young Dr. H. H. Knight had now made his chief study and in which he has added so extensively to our knowledge.

Dr. Geza Horvath, the eminent Director of the Hungarian Museum at Buda Pest, has been responsible for many valuable contributions to American Hemipterology. His discussion of the species common to Europe and America presented at the Zoological Congress at Boston in 1907, and his revisions of American groups have always shown extended study and even when his conclusions are questioned, the illuminating character of his discussions are appreciated.

Dr. A. L. Montandon, of Roumania, during the years 1893 to 1910, contributed a number of papers on the North American Hemiptera, and by exchanges and identifications assisted students in this country in their efforts to build up representative collections of our native species.

Dr. L. Melichar, the Vienna Hemipterist, began his work on American Hemiptera in the nineties and the writer is indebted to him for a number of valuable exchanges as an aid in his comparisons of American and European species or genera. Probably his most important contributions to American Homopterology are found in his very valuable monographs on the different sub-groups of Fulgoridae, notably the Issidae (1906), Dictyophorinae (1912), Acanolininae and Flatinae, and the recent papers on Cicadellinae (1925–27).

For myself, I can claim for this group, only a secondary field of labor, although it has certainly ranked as a major interest from the time I commenced the study of the pine chermes in 1878.

Of a long list of still active workers I shall not speak at length, but I cannot forego mention of the veteran E. P. Van Duzee, whose work for the near half century has done so much to further progress in the studies of this group. His monumental "Catalog of Hemiptera" (1917) is alone a contribution of major worth, but his descriptions and keys in many families are of inestimable value. Other recent workers are J. R. de la Torre Bueno, Parshley, Ball, Sanders, DeLong, Barber, Hungerford, Lawson, Drake, Blatchley and Morrison.

Of later workers not mentioned here, many others have been gathering a wealth of data and gradually working out the details of affinity, life history and ecology which has been the goal that many have sought, but it is evident to all of us that we are only making a start in a field very rich in opportunity. If we can but lay secure foundations on which future workers may build with confidence we shall perhaps have "served our day and generation" and made possible an adequate harmonious structure for the infinite variety of insects included in the group Hemiptera, and which have been at times our hobby, our despair and our ever recurring interest and joy.

BOOK NOTICE.

INSECTS AND CLIMATE. By B. P. Uvarov. Transactions of the Entomological Society of London, Vol. 79 (1931), pp. 1-247, tables I–XXXIX, 53 figures, bibliography and index.

The Editor is breaking all rules in noticing a publication in a Journal but this work is of such importance to all entomologists that it should be brought to the attention of workers in general. It is a very thorough review of the literature on insects and climate and covers the following main subjects (pp. 1–186): Part I. Physical Factors of Insect Life. I. Heat. II. Humidity. III. Other Climatic Factors. IV. Combinations of Several Factors. Part II. Weather, Climate and Insects. V. Relation of Weather to Activities. VI. Daily and Annual Cycles. VII. Climate and Distribution. VIII. Effect of Climate on Abundance. IX. Climate and Weather in Economic Entomology. Bibliography, pp. 187–232, Index to Authors, 233–238, Subject Index, 239–247. This is a summary of the literature similar to Uvarov's previous work, "Insect Nutrition and Metabolism," published in the Transactions, December 31, 1928. It is fully documented and will be the general reference key to the literature up to 1930. Uvarov's two papers are of immense help to entomologists and it is to be hoped that he can continue such work.—C. H. K.

A REVISION OF THE GENUS STRUMIGENYS OF AMERICA, NORTH OF MEXICO, BASED ON A STUDY OF THE WORKERS (HYMN.: FORMICIDÆ).[1]

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Probably no genus of ants has a more world-wide distribution than the genus *Strumigenys*. In spite of this, paradoxical as it may seem, not only are the habits of the ants little known, but undoubtedly there are many species yet to be described. That the genus is poorly represented in the collections in this country is a fact beyond a doubt.

Due to the small size of the workers of the North American species, their obscure color, their slow method of locomotion, and their habit of feigning death, they are a type of ant that is easily apt to be overlooked by collectors. So far as my knowledge goes, the ants are never found above the surface of the soil, another habit which has made the collecting of them still more difficult. The colonies observed by me have all been small, usually numbering only a few dozen individuals at the most. The largest colony I have seen was one of *Strumigenys louisianæ laticephala*, which contained 120 workers, several queens, and many immature forms. The nests of the species of *Strumigenys* are generally found in decaying logs and stumps or in the soil beneath objects lying on the surface.

Usually the colonies are located in the vicinity of the nests of other ants. Whether there is any relationship between the ants, I am unable to say. Some formicologists are inclined to regard the ants as thieves of other ants, with habits similar

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[1]A contribution from the Mississippi Agricultural Experiment Station.

[2]ACKNOWLEDGMENTS.—This paper would not have been possible had it not been for the aid and encouragement that I received from many sources. I am especially indebted to Dr. Carl Menozzi, of Chiavari, Italy, who very graciously allowed me the privilege of studying Emery's types. Drs. W. M. Wheeler, W. S. Creighton, W. M. Mann, and W. A. Hilton also kindly furnished me with material, as did the following: Mary Talbot, Helen Green, E. E. Byrd, J. W. Ward, S. W. Simmons, R. M. Graham, G. W. Haug, E. Lott, H. Dietrich, G. L. Bond, and others. To all of these I wish to extend my sincere thanks. The paper would have been far from complete had it not been for Mrs. Sarah Hoke DeBord, who furnished the many illustrations that help to bring out characters too elusive for words. Lastly, I desire to express my sincere gratitude to Professor R. W. Harned, who has as ever very kindly aided and encouraged me in all my studies on ants.

to those of *Solenopsis molesta* Say. It has also been mentioned that the ants, especially those with long mandibles, such as *Str. louisianæ*, might possess the power of leaping forward with them like various species of *Odontomachus*.

Although the generic characters are extremely clear cut as, for instance, the six-segmented antennae, the cordate head, the peculiar type of pilosity, and the usual spongiform processes of both petiole and postpetiole, some of the species at least are not always so distinctive. Like Emery, I have found the head to be the most distinctive part of the body; hence in this paper I have given a large part of the descriptive matter to an enumeration of its characters. In order to bring out additional structures too elusive for words, I have resorted to illustrations.

My excuse for this paper, if there should be one, is that the species of *Strumigenys* are entirely too poorly known in North America. The nine species formerly known for this country were described almost without exception by Emery and Forel. Not only are practically all the types located in foreign countries but also the descriptions of them are in foreign languages in inaccessible magazines. I have been especially fortunate, however, in being able to examine types of the six following species: *Str. rostrata*, *Str. pergandei*, *Str. pulchella*, *Str. ornata*, *Str. clypeata* var. *pilinasis*, *Str. membranifera* subsp. *simillima*. I have not seen types of *Str. clypeata*, *Str. louisianæ*, nor *Str. margaritæ*. Specimens studied by me of the last three species are supposed to be authentic enough, however, for me not to hesitate in basing descriptions on them. I have described the following new forms: *Str. angulata*, *Str. creightoni*, *Str. dietrichi*, *Str. clypeata* var. *laevinasis*, *Str. louisianæ* subsp. *laticephala*, *Str. missouriensis*, and *Str. sculpturata*. Although seven new North American species have thus been added to our fauna and the number of forms in the genus almost doubled, I feel that there are even yet a number of undescribed species.*

*After this article was placed in the hands of the printer, I received several species of *Strumigenys* for identification. None of these were new to science, but since they add a number of distributional records to this paper they are mentioned here.

Strumigenys pergandei Emery was taken by Dr. C. H. Kennedy from an old rotten stump at Shriner's Grove, London, Ohio on September 25, 1931.

Strumigenys pulchella Emery was collected by Miss Mable Schramm from a wet log, in Huron Bog, Willard, Ohio, on August 15, 1931. As well as in a white oak log, 4 miles south of Lowell, Ohio, on September 8, 1931.

The generic description of the *Strumigenys* worker given below has been copied from Emery in Genera Insectorum, Fasc. 174C, p. 319 (1922).

"*Worker.*—Not generally varying much in size. Head cordiform, generally longer than wide, not including the mandibles, very noticeably narrowed anteriorly, arc-like emarginate posteriorly, with rounded posterior angles.

Clypeus prolonged over the base of the mandibles, its anterior border curved, rarely straight, occasionally emarginate. Frontal carinae wide, extending above the eye and limiting a scrobe for the base of the antennal scape.

Eye placed under the scrobe.

Mandibles very variable with respect to length, and shape of teeth.

Antennae of 6 segments; first segment of funiculus large, the second and third equal, the two last segments large, especially the last, which is very long; these two segments constitute the club.

Epinotum more or less armed.

Petiole pedunculate, surmounted by a node. Postpetiole rounded or oval. In many species there are at the borders of the node of the petiole and postpetiole, on the ventral surfaces of these segments, even sometimes at the posterior border of the epinotum, some membranous appendages, yellowish and very thin, which, when they are developed, take a spongy aspect."

Wheeler in Bull. Amer. Mus. Nat. Hist., Vol. XLV, p. 668 (1922) divides the genus into two subgenera, namely, *Strumigenys* and *Cephaloxys* F. Smith (=*Trichoscapa* Emery). The keys to the subgenera below are adapted from Wheeler.

KEYS TO SUBGENERA OF STRUMIGENYS.

1. "Mandibles slender, porrect, subparallel; with two or three teeth at the apex; approximate at their base, which is not covered by the short clypeus..... **Strumigenys** sensu strictu.
   Mandibles rather short and flattened, narrowly subtriangular; with numerous small teeth along their apical margin; remote at their base, which is covered by the projecting clypeus
   Cephaloxys F. Smith (=Trichoscapa Emery").

KEY TO SPECIES OF SUBGENUS STRUMIGENYS.

1. Average size, 2.25 mm.; head not remarkably robust, with rounded occipital lobes; color light ferruginous, with scarcely darker gaster. (Pl. I, Fig. 1)..... **louisianæ** Roger.
   Average size 2.5 mm.; head rather robust, with posteriorly broad, somewhat angulate occipital lobes; color dark ferruginous with variably infuscated gaster. (Pl. I, Fig.2)..... **louisianæ laticephala** subsp. nov.

Strumigenys (S.) louisianæ Roger.

Str. louisianæ Roger, Berlin Ent. Zeitschr. Vol. 7, p. 211 (1863) worker.
Str. louisianæ Emery, Zool. Jahrb. Syst. Vol. 8, p. 327 (1895).
Str. unispinulosa Emery, Bull. Soc. Ent. Ital. Vol. 22, p. 67, pl. 7, f. 5 (1890), worker and female.

Worker.—Length: 2.25 mm. (Pl. I, Fig. 1).

Head, excluding mandibles, broad in proportion to its length. Eyes well developed, coarsely facetted. Mandibles somewhat longer than one-half the remainder of the head; masticatory border of each with one small preapical tooth and two large apical teeth, which contain two small teeth between them. Clypeus triangular, much broader than long, with very transverse or truncate anterior border. Antennal scapes moderate, curved but not angulate basally; last segment distinctly longer than the remaining segments of the funiculus. Thorax short, moderately robust; pro-mesonotal suture poorly developed or lacking; meso-epinotal constriction distinct. Epinotal spines about as long as broad, acute apically, directed slightly upward, backward, and outward; each with a verry narrow and thin infraspinal lamella. Petiole almost devoid of spongiform processes except for a very narrow area on its posterior border. Postpetiole with a small amount present on its ventral and posterior borders. First gastric segment, in addition to longitudinal striae on the base, reticulately shagreened.

Body reticulate-punctate, subopaque with the following exceptions: mandibles, funiculi, tarsi, and apical portion of gaster.

Head densely, thorax less densely, covered with short depressed, scale-like hairs; petiole, postpetiole, and gaster with longer and more erect clavate hairs.

Ferruginous; appendages lighter, gaster slightly darker.

Strumigenys louisianæ can be readily distinguished from the other species of the genus by the characters here enumerated: (1) its extremely long, slender, sub-cylindrical mandibles, which are peculiarly toothed; (2) its very broad, triangular shaped clypeus, the anterior border of which is decidedly truncate; (3) the large, abundant, scale-like hairs on the head; (4) the almost complete absence of spongiform processes on the petiole and postpetiole; and (5) the reticulate shagreening of the dorsal surface of the first gastric segment.

Type locality: Louisiana (Roger).

Additional localities: Bay Minette River, Baldwin County, Alabama (W. S. Creighton); Sibley, Mississippi (Andrew Fleming).

This species is listed as occurring from Florida westward to Texas and as far south as Costa Rica. Since I have not seen the specimens on which the above records are based, I cannot

be sure whether the specimens in question in many cases were typical *louisianæ* or those of the new subspecies which I am here describing.

This species nests in cavities in rotten logs and stumps or in the soil beneath objects lying on the surface. Mr. Andrew Fleming found winged females present in a nest at Sibley, Mississippi, on July 4. The colony was found in a cavity in an old locust stump.

Strumigenys (S.) louisianæ laticephala subsp. nov.

Worker.—Length: 2.5 mm. (Pl. I, Fig. 2).

Very similar to *louisianæ* with the following noticeable differences: namely, (1) its larger size; (2) its relatively broader head; and (3) its darker color. General color deep ferruginous brown with infuscated gaster; the color of the latter variable, often approaching black.

Type locality: Longview, Mississippi (M. R. Smith).

Described from 10 workers. Cotypes are in the collection of the Department of Entomology of the Mississippi A. and M. College and my collection.

Other localities: Louisville, Columbus, West Point, Ripley, and Landon, Mississippi (M. R. Smith, J. W. Ward, E. E. Byrd, G. W. Haug, S. W. Simmons); Decatur, Alabama (W. S. Creighton).

This ant is probably commonly distributed throughout the Gulf States. The exact limits of its distribution are uncertain; it may extend much further than is at present known.

Str. louisianæ subsp. *laticephala* is apparently our most common form of *Str. louisianæ* in Mississippi. Nests of these ants are most commonly found in the soil beneath stones, boards, and other objects. One fine colony was found in a crevice in a well rotted log. A nest found in the soil beneath a flower pot at Columbus, Mississippi, on August 4, contained 120 workers, 2 wingless queens, 2 winged queens, and many immature forms. Another colony found at Longview, Mississippi, contained 94 workers, 1 dealate queen, and many immature forms. At West Point, Mississippi, on June 20, a nest was found which contained 77 workers, 5 males, and 1 dealate queen. Males have been taken at the same locality as late as July 10. Frequently the ants are found nesting in very dry soil. On many occasions we have found them nesting in close proximity to colonies of other ants, such as: *Pheidole*

dentata Mayr, *Pheidole vinelandica* Forel, *Solenopsis molesta* Say, *Prenolepis* (*Nylanderia*) sp., *Ponera trigona* var. *opacior* Forel, *Monomorium minimum* Buckley, *Iridomyrmex humilis* Mayr and others.

KEY TO SPECIES OF SUBGENUS CEPHALOXYS FOR IDENTIFICATION OF WORKERS.

1. Dorsal surface of first gastric segment clearly shagreened, subopaque; infraspinal lamella absent. (Pl. II, Fig. 7)..... **margaritæ** Forel.
   Dorsal surface of first gastric segment smooth and shining; infraspinal lamella present..... 2
2. Prothorax not only flattened, but also very strongly marginate laterally; head almost destitute of pilosity except for a pair of short, more or less erect, club-like hairs on the vertex. (Pl. III, Fig. 10), **membranifera** subsp. **simillima** Emery
   Prothorax not as above; head covered more or less abundantly with variable types of pilosity..... 3
3. Clypeus with a few, very long, erect, enlarged hairs, which give it a decorated effect..... 4
   Clypeus, although bearing different types of pilosity, distinctly not as above..... 5
4. Clypeus broadly rounded anteriorly; erect hairs very much enlarged apically. (Pl. II, Fig. 5)..... **ornata** Mayr
   Clypeus very acute anteriorly; pilosity not suddenly enlarged apically. (Pl. II, Fig. 6)..... **dietrichi** sp. nov.
5. Mandibles very much elongated, slender, and somewhat subparallel; each with a distinct tooth on its inner margin just in front of the clypeus, which is followed by a long toothless space, before the apical teeth are reached..... 6
   Mandibles only moderately or not at all elongated; if similar to the mandibles described above, the tooth on their inner margin is hidden beneath the clypeus when the mandibles are closed..... 7
6. Clypeus decidedly truncate anteriorly, thus giving the head a subrectangular appearance; antennal scapes not only short but very strongly angulate basally. (Pl. I, Fig. 3)..... **angulata** sp. nov.
   Clypeus, although moderately truncate anteriorly, not enough to give a decidedly subrectangular appearance to the head; scapes longer and less angulate basally. (Pl. I, Fig. 4)..... **pergandei** Emery
7. Anterior border of clypeus either truncate or emarginate..... 12
   Anterior border of clypeus rounded..... 8
8. Sides of the head gradually converging anteriorly..... 9
   Sides of the head not perceptibly converging anteriorly, more or less subparallel..... 11
9. Clypeus with short, appressed, squamiform or scale-like hairs. (Pl. III, Fig. 9)..... **clypeata** Roger
   Clypeus with longer, more or less erect hairs..... 10
10. Dorsal surface of clypeus convex, subopaque. (Pl. III, Fig. 12), **clypeata** var. **pilinasis** Forel
    Dorsal surface of clypeus depressed, surface slightly glabrous. (Pl. III, Fig. 11)..... **clypeata laevinasis** var. nov.
11. Head relatively robust in proportion to its length; upper half rugulose or tuberculate; mandibles rather robust, convex. (Pl. IV, Fig. 14), **missouriensis** sp. nov.
    Head relatively slender in proportion to its length; surface, although reticulate-punctate not tuberculate; mandibles slender and somewhat laterally compressed. (Pl. IV, Fig. 13)..... **pulchella** Emery

12. Mandibles somewhat narrowly triangular, flattened dorso-ventrally; each with large, coarse teeth on its entire inner border; clypeus broadly truncate or slightly emarginate. (Pl. II, Fig. 8).....**rostrata** Emery
Mandibles triangular but shorter; each toothed on only a part of its inner surface; clypeus slightly truncate but never emarginate.....13
13. Hairs on head rather abundant, distinctly squamiform. (Pl. IV, Fig. 16), **creightoni** sp. nov.
Hairs on head less abundant, longer, and, although slightly enlarged apically, not distinctly squamiform. (Pl. IV, Fig. 15)..**sculpturata** sp. nov.

Strumigenys (C.) margaritæ Forel.

Str. margaritæ Forel, Trans. Ent. Soc. London, p. 378 (1893), worker, female, male.
Str. margaritæ Emery, Bull. Soc. Ent. Ital. Vol. 26, pl. 1, f. 6 (1894), worker.

Worker.—Length: 1.8–2 mm. (Pl. II, Fig. 7).

Head gradually but not strongly converging to the apices of the two closed mandibles. Clypeus broader than long; its anterior border either straight and truncate or else very broadly and feebly rounded; only very slightly narrower anteriorly than posteriorly. Mandibles approximately one-sixth the length of the head alone, each flattened dorso-ventrally, with 12–14 small but rather clearly defined teeth. Eyes large, distinct, coarsely facetted, easily visible from the front when the scapes are not held close to the head. Antennal scapes robust, much narrowed basally but scarcely as angulate as with some of the other species of *Strumigenys*. Thorax short, moderately robust; viewed laterally it forms, except for the interruption in the meso-epinotal region, an almost continuous and moderate arch. Meso-epinotal constriction distinct. Epinotum with two rather prominent, acute, slightly divergent spines, which are directed somewhat upward, backward, and outward; the membranous infra-spinal lamellar process lacking beneath each. Petiole and postpetiole remarkable because of the almost complete absence of the abundant spongiform processes which are so common to other species of *Strumigenys;* with this species the posterior border of the petiole and the ventral and posterior surfaces of the postpetiole alone bear a small amount of aerolar membrane that could scarcely be called spongiform.

Body very abundantly and finely reticulate-punctate, subopaque; mandibles and apical portion of gaster differently sculptured, more glabrous. Dorsal portion of first gastric segment finely shagreened, subopaque; lacking coarse longitudinal striae at the base.

Head and thorax covered with short, curved, weakly developed, scale-like hairs; the hairs on the petiole, postpetiole, and gaster longer, more clavate, suberect.

Ferruginous; gaster scarcely darker.

This is another very distinct species. The characters which distinguish it are as follows: (1) the peculiarly shaped clypeus, which is only very slightly narrower anteriorly than posteriorly, and the anterior border of which is decidedly truncate in appearance; (2) its robust antennal scapes, which are not angulate basally; (3) its large, coarsely facetted eyes;

(4) the absence of membranous infra-spinal lamella beneath each epinotal spine; (5) the almost complete absence of spongiform processes on the petiole and postpetiole; and (6) the peculiar shagreening on the dorsal surface of the first gastric segment as well as the absence of coarse striae at the base.

Type locality: Island of St. Vincent (West Indies).

Other localities: New Braunfels, Texas (W. M. Wheeler); Comal County, Texas (C. F. Baker's collection).

S. margaritæ, which was originally described from an island of the West Indian group, may possibly be distributed throughout the Gulf States, although to date, so far as I am aware, it has been taken only in Texas.

I am not in possession of any data concerning its biology.

Strumigenys (C.) membranifera subsp. **simillima** Emery.

Str. membranifera subsp. *simillima* Emery, Bull. Soc. Ent. Ital. Vol. 22, p. 69, pl. 8, f. 5 (1890), worker.

Worker.—Length: 1.5 mm. (Pl. III, Fig. 10).

Head proportionately shorter and more robust than with the other species of *Strumigenys*. Anterior portion of the head distinctly subrectangular due to the peculiar conformation of the clypeus and sides of the head. Clypeus decidedly broader than long, the posterior margin rounded, the anterior border so broadly and very gently rounded as to appear sub-truncate at a superficial glance. Frontal area faintly impressed, only slightly discernible. Mandibles small, sub-triangular, approximately one-fifth the length of the head alone, the superior surface of each distinctly visible. Antennal scapes extremely short and robust, each very strongly angulate basally. Eyes extremely small. Each side of prothorax with a sharp, well developed longitudinal carina, which thus causes the prothorax to be laterally marginate throughout. Meso-epinotal constriction lacking. Spines of epinotum apparently lacking, their absence represented by a very wide, thin, vertical lamella on each side. Petiole and postpetiole with abundant spongiform processes, which are attached to their ventral, lateral, and posterior surfaces and are apparently more lamellar in nature than with the other species of *Strumigenys*.

Head very thickly and coarsely reticulate-punctate, subopaque; dorsal surface of thorax very faintly so, almost glabrous. Mandibles, clypeus, frontal area, pleurae of meso- and metathorax, dorsal surfaces of petiole and postpetiole, and all of gaster smooth and shining.

Pilosity of the body comparatively sparse. Head with a pair of short, erect, club-like hairs on the vertex, and 6–7 somewhat similar hairs on the anterior border of the antennal scapes; remainder of body with the exception of the tibiae, tarsi, and the apex and ventral surface of gaster practically devoid of hairs.

Light to dark ferruginous brown.

This is not only one of the commonest forms of *Strumigenys* in Mississippi, but is also one of the smallest and most easily recognized species. The ant can easily be recognized from other species of Strumigenys by (1) the peculiarly subrectangularly shaped anterior portion of the head; (2) its distinctive type of mandibles, the superior surfaces of which are always visible; (3) its very short, robust, angularly bent antennal scapes; (4) its strongly and laterally margined prothorax; (5) the lamellar plates on the epinotum instead of spines; (6) the almost complete absence of scale-like hairs on the body; (7) the presence of two short, erect, club-like hairs on the vertex of the head. My Mississippi specimens have been carefully compared with a cotype from Emery's collection. I have been unable to find any characters by which the two might be distinguished.

Type locality: St. Thomas (Virgin Islands).

Other localities: Avera (H. Dietrich and E. Lott), Waynesboro (G. L. Bond), West Point (M. R. Smith and E. E. Byrd), Belzoni (G. W. Haug), Columbus and Greenwood (J. W. Ward), Mississippi.

Undoubtedly this subspecies occurs throughout the Gulf States certainly as far west as the Mississippi River.

This species has usually been found nesting in the soil beneath various objects which lay on the surface, such as pieces of wood, bricks, stone, concrete, etc. In most instances the soil was rather dry. In one case a colony was found nesting in the woodwork of an old deserted house and in another instance a colony was observed in the bulb of a gladiolus. The largest colony noted probably contained not more than from 75 to 100 individuals. Occasionally the ants are found nesting in close proximity to other ants, but whether there is any association between the *Strumigenys* and the other ants no one has been able to say. We have found *Str. membranifera simillima* nesting near colonies of the following species of ants: *Pheidole dentata* Mayr, *Lasius niger* var. *americana* Emery, *Prenolepis* (*N.*) sp., and *Monomorium minimum* Buckley.

Solitary, wingless queens were collected on a number of occasions. A winged queen was taken at Columbus, Mississippi, on July 18, 1930.

Strumigenys (C.) ornata Mayr.

Str. ornata Mayr, Verh. Zool. Bot. Ges. Wien, Vol. 37, p. 571 (1887), worker.
Str. ornata Emery, Bull. Soc. Ent. Ital. Vol. 22, pl. 8, f. 2 (1890); Zool. Jahrb. Syst. Vol. 8, p. 328, pl. 8, f. 20 (1895), worker.

Worker.—Length: 1.6–1.7 mm. (Pl. II, Fig. 5).

Head proportionally slender, gradually converging to a point at the apex of the closed mandibles. Clypeus as long as its greatest width at the base; its sides gradually converging anteriorly and fusing into the rather evenly rounded oval anterior border. Mandibles approximately one-seventh the length of the head alone; teeth lacking on the basal third of each. Antennal scapes moderate, scarcely angulate basally. Thorax with a median pro-mesothoracic carina and a lateral carina on each side of the basal surface of the epinotum, leading to the epinotal spines. Petiole and postpetiole with large spongiform processes, which hide a large part of the petiole and all but the dorsal surface of the postpetiole.

Head, thorax, and petiole reticulate-punctate, subopaque; mandibles, basal portion of clypeus, frontal area, pleurae of thorax, dorsal surface of postpetiole and gaster, smooth and shining.

Clypeus with a pair of exceedingly long, slender, erect hairs and also 8 shorter erect, clavate hairs; remainder of head with a very moderate amount of short, curved, scarcely clavate-like hairs. Hairs on gaster rather sparse, very long and slender, mostly erect, thickest near apex.

Ferruginous brown; gaster varying from deep brown to almost black.

This species can easily be recognized at a glance by the peculiar shape and arrangement of the hairs on the clypeus, which give the head an ornate appearance, hence the name *ornata*. The clypeus with its convergent sides and oval anterior border is also distinctive, although it bears something of a resemblance to the clypeus of *dietrichi*, *clypeata* and its varieties, *pilinasis*, and *laevinasis*. This is one of the smallest species of our *Strumigenys* (1.6–1.7 mm.).

Type locality: Washington, District of Columbia (Theo. Pergande).

Other localities: Louisville, Mississippi (G. W. Haug); Spring Hill, Mobile, Alabama (W. S. Creighton).

This species has been collected so infrequently that its real distribution in North America is inadequately known.

The single worker, which was taken at Louisville, Mississippi, was found on the ground beneath a well rotted pine stump in a moderately dense pine and oak woods. The ground in the vicinity of the stump was covered with a dense layer of leaves. Pergande, who seems to have collected this species more than anyone else, wrote Emery that he had collected the ants amongst

leaves in the vicinity of streams, in cavities in tree trunks, in the earth, and also in the siftings for certain shade and moisture loving beetles. One would infer from the above remarks that *Str. ornata* is strictly a moisture or shade loving type of ant and for that reason is most often associated with the woodland type of ant fauna.

Strumigenys (C.) dietrichi sp. nov.

Worker.—Length: 1.7–1.8 mm. (Pl. II, Fig. 6).

Head proportionately long and slender, very strongly converging anteriorly to the apices of the closed mandibles. Mandibles approximately one-sixth the length of the head alone; projecting out prominently in front of the clypeus; each with a prominent acute basal tooth, which is concealed beneath the clypeus when the mandibles are closed. This tooth is followed by a toothless space which occupies scarcely one-half the length of the exposed part of the mandibles, and is in turn followed by the apex of the mandibles that bears 4 or 5 irregular teeth and then a number of subequal denticulae. Clypeus longer than broad, its anterior border forming medianly almost as sharp an apical point or angle as that formed by the posterior border at its insertion between the frontal carinae. Antennal scapes moderate, not angulate basally as with some of the other species; last segment of antennae somewhat longer than the remainder of the funiculi. Thorax with a moderately distinct meso-epinotal constriction. Epinotal spines well developed, acute apically, directed slightly upward, outward, and backward; each with a moderately broad infraspinal lamella beneath. Spongiform appendages of the petiole and postpetiole well developed; present on the ventral surface and posterior border of the petiole and all of the postpetiole except the dorsal surface.

Body reticulate-punctate, subopaque, with the following exceptions: mandibles, pleurae of meso- and metathorax, dorsal surface of postpetiole and gaster, which are smooth and shining. Clypeus and region of frontal area faintly shining due to the finer sculpture. Thorax with a tendency to small longitudinal rugulae, dorsally.

Head covered with moderately abundant and moderately long, curved, scarcely squamiform hairs. Clypeus with 8–10 long, slightly clavate, suberect to erect hairs, which in length and arrangement bear a striking resemblance to those of *Str. ornata*. Petiole, postpetiole, and gaster sparsely covered with long, sub-erect to erect hairs.

Body ferruginous; gaster very dark, almost black; appendages lighter.

This very striking species is easily recognized by the following characters: (1) its long and sharply angulate clypeus, (2) the peculiar arrangement and shape of the hairs which adorn the clypeus, and (3) the unsquamiform or unscale-like hairs which cover the head. *Str. dietrichi* resembles *Str. ornata*, but can be easily distinguished from that species by

the following characters of the workers: (1) the much more acute anterior border of the clypeus, and (2) the distinctly different type of erect hairs on the clypeus.

Type locality: Lucedale, Mississippi, (H. Dietrich).

Described from 7 workers, the cotypes of which are in the collection of the Department of Entomology of the Mississippi A. & M. College and my collection.

Mr. Dietrich, who collected specimens of the ants on different occasions, stated that he found them among the woody frass of logs and stumps while looking for small beetles.

Strumigenys (C.) angulata sp. nov.

Worker.—Length: 2–2.5 mm. (Pl. I, Fig. 3).

Head somewhat similar to that of *S. pergandei*, but much more sub-rectangular anteriorly. Eyes variable in size, usually small, and not visible from a frontal aspect of the head. Mandibles approximately three-eighths the length of the head alone; elongate, slender, laterally compressed, converging apically; each mandible with a distinct tooth in front of the anterior border of the clypeus, followed by a very long toothless interval until the apex is reached where there are four prominent teeth followed in turn by five much smaller teeth until the longer, apical tooth is reached. Clypeus almost one and one-half times as broad as long; anterior border transverse, lateral borders converging with the sides of the head in such manner as to give the anterior part of the head a distinctly sub-rectangular effect; both the anterior and lateral borders of the clypeus faintly but distinctly scalloped. Scapes of antennae much more robust than with *Str. pergandei*, each exceedingly angulate basally. Prothorax with a distinct longitudinal carina on each side. Both pro- and mesothorax with a well developed, median carina. Meso-epinotal constriction distinct. Petiole, postpetiole, and gaster not strikingly different from that of *Str. pergandei*.

Body reticulate-punctate, subopaque, with the following exceptions: mandibles, pleurae of most of the thorax, dorsal surface of postpetiole, and all of gaster, smooth and shining.

Pilosity of head similar to that of *Str. pergandei*, but apparently the hairs are not so numerous or perhaps so large. Gaster with similar but more abundant pilosity than that of *Str. pergandei*.

Ferruginous brown; gaster slightly darker.

Str. angulata, as its name signifies, can readily be distinguished from the other species of *Strumigenys* by the very distinct (sub-rectangular) appearance of the anterior part of its head as well as by the very strongly angulate appearance of its antennal scapes. The mandibles bear a close resemblance to those of *Str. pergandei*, but are considerably longer and differently toothed. In addition to the characters just mentioned, the scale-like hairs of the head, although similar to those

of *Str. pergandei*, are noticeably smaller. Although *Str. pergandei* is closely related to *Str. angulata*, one should have little difficulty, however, in separating the two because of the many distinct differences here mentioned. From *Str. membranifera simillima*, which also has a somewhat similarly shaped head and angulate scapes, *Str. angulata* can be distinguished by the mandibles, size, and numerous other characters.

Type locality: Louisville, Mississippi (M. R. Smith).

Described from 14 workers, cotypes of which are in the collection of the Department of Entomology of the Mississippi A. & M. College and my collection.

This very distinctive species was found nesting in a crevice in a rotten log in a rather dense woodland thicket. Since the species has been taken only once in the state, very little is known concerning its biological habits.

Strumigenys (C.) pergandei Emery.

Str. pergandei Emery, Zool. Jahrb. Syst. Vol. 8, p. 326, pl. 8, f. 17, 18 (1895), all castes.

Worker.—Length: 2.25–2.5 mm. (Pl. I, Fig. 4).

Head somewhat similar to that of *Str. angulata*, but less rectangular anteriorly. Eyes not visible from a frontal aspect. Mandibles approximately one-fourth the length of the head alone; elongate, slender, laterally compressed, gradually converging apically; each mandible with a prominent robust tooth on its inner margin just in front of the clypeus, this in turn followed by a very long toothless space until the apex of the mandibles is reached where there is a large acute tooth followed by a broadly rounded tooth, and this in turn by a small acute tooth, then a broadly rounded tooth followed by several smaller more or less indistinct teeth. Clypeus with an almost straight, transverse anterior border; lateral borders broadly rounded, gradually converging into the sides of the head without any definite limits. Antennal scapes not only more slender than those of *Str. angulata*, but less angulate basally. Thorax with distinct meso-epinotal constriction; epinotal spines well developed, apically acute and distinct from the thin and narrow infraspinal lamella beneath them. Petiole with spongiform processes on its ventral and posterior surfaces, postpetiole similarly but more abundantly covered except on its dorsal surface.

Body reticulate-punctate, subopaque, with the following exceptions: mandibles, pleurae of the thorax, dorsal surface of postpetiole, and gaster, which are mostly smooth and shining.

Hairs on the head numerous, somewhat similar to those of *Str. angulata*, but larger and more abundant; anterior border of the clypeus with many, usually 14–16 clavate hairs; the anterior margin of the antennal scapes with 8–10 similar hairs. Hairs on the gaster sparse, long, and erect, not enlarged apically.

Color variable, ranging from light to dark ferruginous brown; appendages lighter.

This species can be distinguished by the following characters: (1) its peculiarly shaped mandibles; (2) the distinct type of pilosity of the head; (3) and its large size (2.25–2.5 mm.). *Str. angulata* appears somewhat similar to *Str. pergandei* in the shape of its mandibles, but can readily be distinguished by the different arrangement and shape of the teeth. In addition to this there are other differences, such as the shape of the head, shape of the antennal scapes, etc.

Type locality: Washington, District of Columbia (Theo. Pergande).

Other localities: Maryland and Pennsylvania (Theo. Pergande); Brooklyn, New York (L. F. Barnum, Jr.); Pelee Island, Canada (Mary Talbot); Black Pond, Virginia (W. M. Mann); Oakwood, Illinois (M. R. Smith); Beatty, Pennsylvania (Schmidt); Bronxville, New York (Wheeler); Boston, Massachusetts (Forel).

Str. pergandei appears to be more commonly distributed in the northern and eastern sections of North America, especially in the territory east of the Mississippi River.

The ants have been found nesting in the soil beneath stones and also in the wood of well rotted logs. A log from which a colony was taken by Miss Mary Talbot was so well rotted as to be picked apart easily with one's fingers.

At Urbana, Illinois, a winged female was captured on August 7, while in flight, immediately following a light shower of rain. On August 11, a male was taken in the same locality under similar circumstances.

Strumigenys (C.) clypeata Roger.

Str. clypeata Roger, Berl. Ent. Zeitschr. Vol. 7, p. 213 (1863), worker.
Str. clypeata Mayr, Verh. Zool.-Bot. Ges. Wien. Vol. 37, p. 571 (1887), worker; Emery, Bull. Soc. Ent. Ital. Vol. 22, pl. 8, f. 3 (1890), worker; Zool. Jahrb. Syst. Vol. 8, p. 328, pl. 8, f. 21, 22 (1895), worker, female, male.

Worker.—Length: 2 mm. (Pl. III, Fig. 9).

Head, including mandibles, rather slender in proportion to its length. Clypeus scarcely longer than broad, its anterior border evenly and broadly rounded, gradually fusing into the lateral borders without any definite limit. Mandibles approximately one-sixth the length of the head alone; each with a basal tooth (which is hidden beneath the edge of the clypeus when the mandibles are closed) followed by a small, toothless space, and this in turn by the exposed series of more or less irregular teeth. Antennal scapes moderate in size, not angulate

basally. Meso-epinotal suture visible, but the region in that vicinity not strongly constricted as with some of the species. Epinotal spines acute, each with a narrow, thin, infraspinal lamella beneath. Ventral and posterior surface of petiole and practically all but the dorsal surface of the postpetiole with the usual spongiform processes.

Head, thorax, and petiole reticulate-punctate, subopaque. Mandibles, pleurae of meso- and metathorax, dorsal surface of postpetiole, and gaster smooth and shining. On the thorax there is usually a faint median carina running anteriorly-posteriorly.

Clypeus covered with numerous short, appressed, squamiform hairs; remainder of head with rather abundant long, curved, clavate hairs.

Light to dark ferruginous; mandibles, clypeus, and appendages slightly lighter, gaster darker.

Str. clypeata can be distinguished by the following characters: (1) its characteristic clypeus, which is scarcely longer than broad, forms a broadly oval curve; (2) the clypeus is covered by an abundance of short, appressed, squamiform hairs; (3) the remainder of the head contains numerous long, curved, clavate hairs; and (4) the mandibles are flattened dorso-ventrally and bear a row of coarse, irregular teeth on their inner borders. This species, although quite distinctive, has characters which cannot be so easily described as some of the other species of *Strumigenys*. The illustration will bring out these characters far better than a verbal description.

Type locality: Louisiana (Roger).

Other localities: Beatty, Pennsylvania (Schmidt); Carolina (Roger); District of Columbia (Mayr); Lucedale, Mississippi (H. Dietrich).

I have no data on the biological habits of this species.

Strumigenys (C.) clypeata var. **pilinasis** Forel.

Str. clypeata var. *pilinasis* Forel, Ann. Soc. Ent. Belg. Vol. 45, p. 339 (1901), worker.

Worker.—Length: 2.2 mm. (Pl. III, Fig. 12).

Very similar to *clypeata*, but differing in the following characters: (1) more convex and also more coarsely toothed mandibles; (2) more slender epinotal spines; (3) somewhat wider infraspinal lamellae; (4) presence of very fine longitudinal rugulae on the dorsal surface of the thorax; (5) generally finer sculpturing; and (6) the very distinct type of pilosity of the clypeus, the surface of which is covered with rather long, curved hairs, which are not squamiform and only little, if at all, enlarged.

This species, which very closely resembles *clypeata*, can be at once distinguished from it by the nature of the pilosity of the clypeus. There are other characters of less importance, such as those mentioned above.

Type locality: Potomac River, near Washington, District of Columbia (Forel).

I do not possess any information on the distribution or the biology of this species.

Strumigenys (C.) clypeata laevinasis var. nov.

Worker.—Length: 1.8 mm. (Pl. III, Fig. 11).

This species could be very easily mistaken for *Strumigenys clypeata* var. *pilinasis*. Although closely allied to that species, this new *subspecies* shows the following distinct differences: (1) the size (1.8 mm.) is smaller; (2) the head is relatively more slender in proportion to its length; (3) the clypeus is not only more narrowly oval anteriorly but is also much more depressed dorsally; (4) the mandibles are less convex; (5) the clypeus and frontal area on account of their sculpture are decidedly more shining; (6) the pilosity of the head is sparser, longer, and apparently more slender; and (7) the color is much darker.

The most distinct characteristics of this new subspecies are the shape and sculpturing of its clypeus, which are entirely different from that of any other species of *Strumigenys*.

Type locality: Louisville, Mississippi (M. R. Smith).

Described from three workers, the cotypes of which are in the collection of the Department of Entomology of the Mississippi A. and M. College and my collection.

The workers of this species were collected from a cavity in a well rotted log lying in a ravine in a rather densely wooded area. In this same habitat were collected *Strumigenys louisianæ* subsp. *laticephala* and *Strumigenys gunalata*.

Strumigenys (C.) missouriensis sp. nov.

Worker.—Length: 1.5–1.8 mm. (Pl. IV, Fig. 14).

Head rather robust, wider in proportion to its length than with many other species of the genus. Mandibles approximately one-sixth the length of the head alone; not flattened dorso-ventrally; only the apical two-thirds toothed, the latter with well defined more or less regular teeth. Clypeus approximately one-fourth broader than long, very broadly rounded throughout, and weakly scalloped. Antennal scapes moderately robust, angulate basally. Last segment of antennal funiculus slightly longer than the remainder of the funiculus. Thorax with pro-mesonotal suture; meso-epinotal suture represented by a definite but not strong constriction. Prothorax and mesothorax bearing a faint median carina. Epinotum with a carina on each side extending from the meso-epinotal constriction to the base of each spine. Epinotal spines more or less fused with the thin but moderately broad infraspinal lamella beneath each. Spongiform processes of about the same abundance and arrangement as with *Str. pulchella*.

Head, thorax, and petiole reticulate-punctate, subopaque; frontal area of head, pleurae of meso- and metathorax, dorsal surface of postpetiole, and gaster, smooth and shining.

Pilosity of body similar to that of *Str. pulchella* with reference to shape, arrangement, and abundance.

Ferruginous brown; gaster darker, appendages lighter.

In many respects the worker of *Str. missouriensis* bears a striking resemblance to the worker of *Str. pulchella*. This is evidenced by their strong similarity in sculpturing, pilosity, spongiform processes of petiole and postpetiole, and so forth. Upon carefully comparing typical workers of the two species the following differences can be noted in the *Str. missouriensis* worker: (1) the head is proportionally broader and more robust; (2) the mandibles are more robust, not so laterally compressed, and therefore more convex; (3) the antennal scapes are more robust and also more angulate basally; (4) the sculpturing of the head is coarser—that is, more rugulose or tuberculate; (5) the pilosity of the clypeus is much less abundant.

Type locality: Columbia, Missouri (Mary Talbot).

Described from six workers, the cotypes of which are in my collection.

Concerning the nesting habit of this species, Miss Talbot wrote me that the ants were found in an *Aphaenogaster fulva* nest under a stone and were rather deep in the nest, which was located in clay soil on a little bluff over a stream. The nest contained not only workers, but also winged females at the date of collection (August 20, 1929).

Strumigenys (C.) pulchella Emery.

Str. pulchella Emery, Zool. Jahrb. Syst. Vol. 8, p. 327, pl. 8, f. 19 (1895), worker.

Worker.—Length: 1.5–1.66 mm. (Pl. IV, Fig. 13).

Anterior and lateral borders of clypeus forming a rather broad and more or less regular arc, which somewhat approaches a semicircle; both margins usually more or less scalloped. Mandibles approximately one-sixth the length of the head alone; laterally compressed, apically converging; the masticatory borders occupying about one-half of the visible sections of the mandibles; each with a small but distinct tooth on its inner margin, which is probably hidden beneath the clypeus when the mandibles are closed but is visible when the mandibles are open; following the tooth there is a toothless space until the masticatory border is reached, where there are four rather prominent basal teeth followed by a number of smaller, less distinct teeth. Antennal scapes moderate in size, slightly angulate basally. Thorax not robust; viewed laterally it is slightly arched or carinulate medianly, the carina usually distinct throughout the pro- and mesonotum; meso-epinotal constriction

present; faint lateral carinae extending from the meso-epinotal constriction to the epinotal spines, which are moderate in size and clearly distinct from the infraspinal lamella beneath each. Petiole and postpetiole with well developed spongiform processes, which occur on the ventral and posterior border of the petiole and all of the postpetiole except the dorsal surface. Gaster of the usual shape.

Body reticulate-punctate, subopaque with the following exceptions: mandibles, frontal area, the pleurae of the meso- and metathorax, the dorsal surface of the postpetiole, and the gaster, which are smooth and shining.

Pilosity of the head moderately abundant, short, erect, not strongly enlarged apically; anterior border of clypeus usually with 10–12 forwardly directed hairs; hairs on gaster sparse, long, and erect, not enlarged toward their apex.

Color variable, ranging from light ferruginous brown to deep brown; gaster in some specimens approaching black, in others much lighter colored.

Str. pulchella is one of our smallest and most slender bodied species of *Strumigenys*. The ants can be distinguished from related forms by the following characteristics: (1) the mandibles, which are approximately one-sixth the length of the head alone, are peculiarly shaped; each bears on its inner margin near the base a small tooth, which is partly concealed beneath the edge of the clypeus; this tooth is followed by a small toothless space until the masticatory border is reached where there are four rather prominent teeth followed by a number of smaller, more or less indefinite teeth; (2) the clypeus is very broadly and evenly rounded throughout, forming almost a semicircle, its borders usually distinctly scalloped; (3) the scapes are moderate in size and only faintly elbowed basally; (4) the borders of the clypeus have from 10–12 club-like hairs; and (5) the pro- and mesonotum bear a median longitudinal carina.

Type localities: Washington, District of Columbia, and Beatty, Pennsylvania (Theo. Pergande).

Other localities: Urbana, Illinois (M. R. Smith); Columbus, Aberdeen, West Point, and Lucedale, Mississippi (M. R. Smith, G. W. Haug, J. W. Ward, E. E. Byrd, and H. Dietrich); Frankfort and Philadelphia, Pennsylvania (no collector's name); Mobile and Decatur, Alabama, and Taylorsville, Mississippi (W. S. Creighton); Forest Park, Long Island, New York (L. F. Barnum, Jr.).

Judging from the distributional records, *Str. pulchella* is widely distributed in the states east of the Mississippi River

and very probably farther north and west than this. In Mississippi it is one of the commonest species of the genus.

Colonies are very frequently found in the moist frass beneath well rotted pine stumps and logs. Dr. W. S. Creighton in remarking about the nesting habits of the ants said, "I have always found this ant in very much decayed (red rotten) logs in damp situations." This, however, is not their only type of habitat for in Mississippi we have frequently found colonies in the soil beneath objects, such as bricks, stones, pieces of wood etc., and in many cases the situations could not have been spoken of as especially moist or damp.

We have in a number of instances found colonies of *Str. pulchella* in close proximity to the nests of other ants. Whether there was any relation between the two no one has been able to say. Some of the ants found nesting in the vicinity of this species were: *Tapinoma sessile* Say, *Monomorium minimum* Buckley, *Iridomyrmex humilis* Mayr, *Myrmecina graminicola* subsp. *americana* Emery, *Pheidole dentata* Mayr, and others. The colonies which we have found were never large, usually ranging from a half dozen or so individuals to some fifty or sixty. In some instances specimens may have been overlooked due to their small size, obscure color, habit of death-feigning, etc.

Strumigenys (C.) rostrata Emery.

Str. rostrata Emery, Zool. Jahrb. Syst. Vol. 8, p. 329, pl. 8, f. 23, 24 (1895), worker, female, male.

Worker.—Length: 2–2.5 mm. (Pl. II, Fig. 8).

Head, excluding mandibles, viewed from a frontal aspect, appears truncate because of the straight or very feebly emarginate anterior border of the clypeus. Clypeus broader than long, with moderately converging lateral borders. Mandibles approximately one-fifth the length of the head alone; elongate, but yet somewhat narrowly triangular; flattened dorso-ventrally; each provided throughout the entire length of the inner border with a number of large, coarse teeth. Antennal scapes robust; each slightly angulate basally. Thorax rather short and robust, with a pronounced shoulder-like angle on each side at the point of junction between the pro- and mesothorax. Epinotal spines well developed, acute, about as long as broad at the base and distinct from the infraspinal lamellae. Petiole and postpetiole with the usual conspicuous amount of spongiform processes.

Body reticulate-punctate, subopaque, with the following exceptions: mandibles, frontal area, pleurae of the meso- and metathorax, dorsal surface of postpetiole, and all of gaster except the basally striated area.

Pilosity of the head much sparser and smaller than with *Str. pergandei*. Thorax with an extremely long hair at each humeral angle

and at the angles between the pro- and mesothorax. Pilosity of the gaster sparse, erect, long, not enlarged apically, confined mostly to the venter.

Ferruginous brown; first segment of the gaster darker, appendages lighter.

This species can be recognized from most species of *Strumigenys* by its very characteristic mandibles, which are unusually coarsely toothed. Other characters which seem to set it apart from its cogeners are: (1) the rather broad truncate clypeus; (2) the long single hair at the humeral angles of the thorax and at the angles made by the pro- and mesothoracic segments; and (3) the robust, somewhat angulate antennal scapes.

Type locality: Washington, District of Columbia (Theo. Pergande).

Other localities: Virginia, near Plummers Island, Maryland (W. M. Mann); Angelsea, New Jersey (determined by Pergande); Claremont, California (C. F. Baker); Baldwin County, Alabama (W. S. Creighton).

The distributional records show that *Strumigenys rostrata* is distributed as far north as New Jersey and westward to California.

Unfortunately I possess little information on the biology of this species. Dr. W. S. Creighton, who took a single worker of this species in Baldwin County, Alabama, informed me that the specimen was obtained on the bark of a decaying stump.

Strumigenys (C.) creightoni sp. nov.

Worker.—Length: 1.9–2.1 mm. (Pl. IV, Fig. 16).

Head resembling that of *Str. pulchella*, but proportionally narrower anteriorly. Anterior border of clypeus straight or very faintly rounded, thus giving the clypeus a much more decidedly truncate appearance than with *Str. pulchella*. Mandibles not only more robust but also more flattened dorso-ventrally and without the strongly reflexed apical masticatory border of *Str. pulchella*. The longitudinal carina of the pro- and mesothorax very poorly developed, those of the epinotum very weak or missing. Sculpturing similar to that of *Str. pulchella* but much coarser, thus giving the body a more granulated appearance. Pilosity of head rather abundant, short, similar to that of *Str. pergandei*, but apparently not quite so large. Border of clypeus with 14–16 anteriorly directed scale-like hairs.

Ferruginous; mandibles, antennae, and legs lighter.

This species, although bearing considerable resemblance to *Str. pulchella*, shows its distinctiveness in the following characters: (1) its more flattened and differently shaped mandibles; (2) its proportionally narrower head anteriorly; (3) its more

truncated clypeus; (4) the more abundant and spatulate shaped hairs of the head; (5) the absence of, or weak development of, the lateral carinae of the thorax; and (6) its larger size (2.1 mm.).

Type locality: Spring Hill, Mobile, Alabama (W. S. Creighton).

Described from four workers, the cotypes of which are in my collection.

Strumigenys (C.) sculpturata sp. nov.

Worker.—Length: 1.75–1.8 mm. (Pl. IV, Fig. 15).

Very closely allied to *Str. pulchella*, but distinct from this species in the following characters: namely, (1) its more robust head, the width of which is greater in proportion to its length; (2) the more rugulose or tuberculate sculpturing of its head; (3) its more robust and coarser type of mandibles; and (4) the decidedly truncate shape of the anterior border of its clypeus. From *Str. missouriensis*, to which it also bears a striking resemblance, it can be at once separated by the shape of its clypeus, as well as by the slightly less robust mandibles.

Type locality: Aberdeen, Mississippi (M. R. Smith).

Described from seven workers, the cotypes of which are in the collection of the Department of Entomology of the Mississippi A. & M. College and my collection.

To this species I have also referred specimens from Ripley, Mississippi (S. W. Simmons) and Black Pond, Fairfax County, Virginia (W. M. Mann).

This species nests beneath the bark of rotten logs and stumps as well as in the soil beneath objects lying on the surface.

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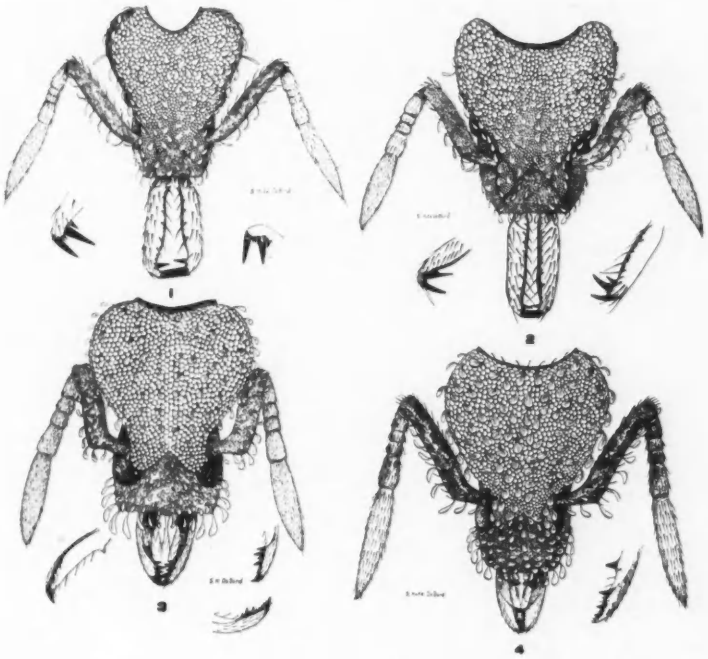

Fig. 1. Frontal view of head, and mandibles of *Str. louisianæ* Roger.
Fig. 2. Frontal view of head, and mandibles of *Str. louisianæ laticephala* subsp. nov.
Fig. 3. Frontal view of head, and mandibles of *Str. angulata* sp. nov.
Fig. 4. Frontal view of head, and mandible of *Str. pergandei* Emery.

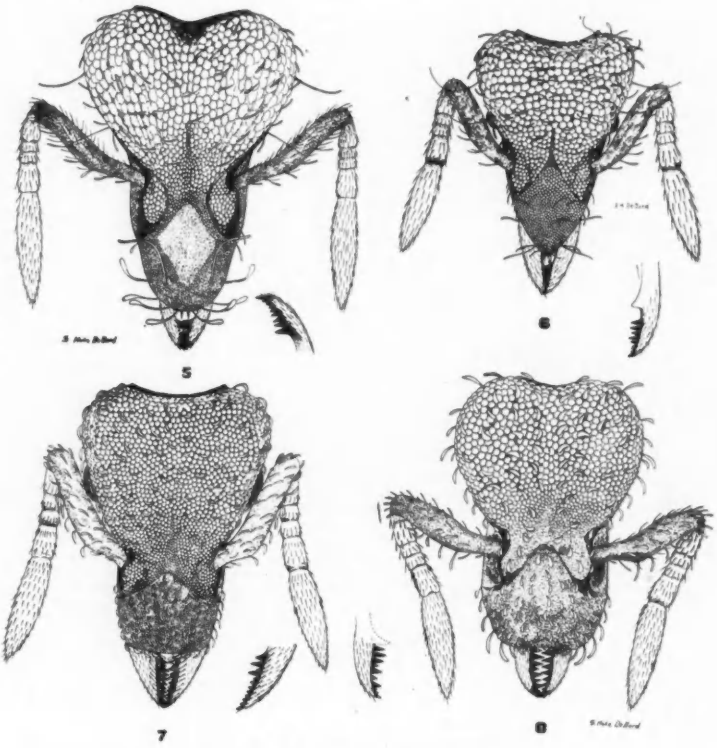

Fig. 5. Frontal view of head, and mandible of *Str. ornata* Mayr.
Fig. 6. Frontal view of head, and mandible of *Str. dietrichi* sp. nov.
Fig. 7. Frontal view of head, and mandible of *Str. margaritæ* Forel.
Fig. 8. Frontal view of head, and mandible of *Str. rostrata* Emery.

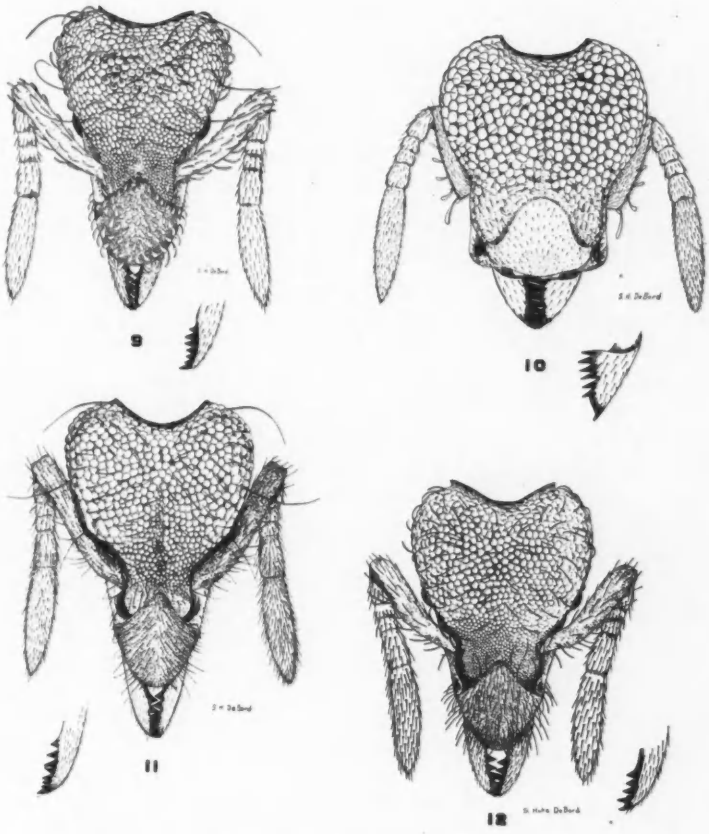

Fig. 9. Frontal view of head, and mandible of *Str. clypeata* Roger.
Fig. 10. Frontal view of head, and mandible of *Str. membranifera* subsp. *simillima* Emery.
Fig. 11. Frontal view of head, and mandible of *Str. clypeata* var. *laevinasis* var. nov.
Fig. 12. Frontal view of head, and mandible of *Str. clypeata* var. *pilinasis* Forel.

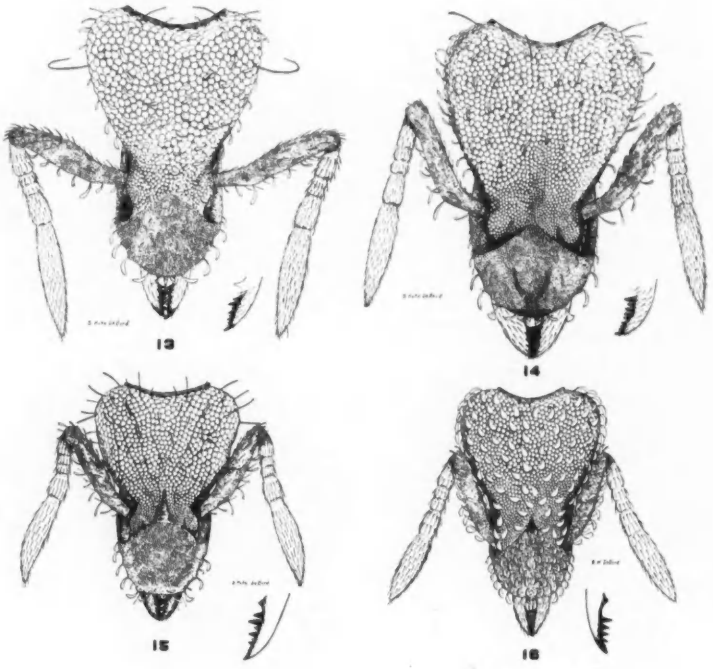

Fig. 13. Frontal view of head, and mandible of *Str. pulchella* Emery.
Fig. 14. Frontal view of head, and mandible of *Str. missouriensis* sp. nov.
Fig. 15. Frontal view of head, and mandible of *Str. sculpturata* sp. nov.
Fig. 16. Frontal view of head, and mandible of *Str. creightoni* sp. nov.

A PRELIMINARY REVISION OF THE AMBUSH BUGS OF NORTH AMERICA, (HEMIPTERA, PHYMATIDÆ).*

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INTRODUCTION.

The present paper is the result of a study of as many North American species of this family as could be obtained. Approximately three thousand five hundred specimens were examined, and several undescribed species were encountered in both of the genera found in this region, namely, *Phymata* and *Macrocephalus*. Most of the work on the North American forms has been done by Europeans, especially Handlirsch and Melin. These authors, however, studied relatively few specimens so that several species remained undescribed. These have been lumped under the old names by American workers, as has been shown by the names applied to specimens received for study. Further study of forms that appear new but are represented by too few specimens to warrant hasty conclusions, is necessary before a complete revision is published. The writer hopes to complete such a revision in the near future, and will be very glad to receive material for determination from North and Central America.

ACKNOWLEDGMENTS.

The writer wishes to express his acknowledgments to those who in some special way have given aid in the preparation of this paper. He is especially indebted to Dr. Max Beier, of the K. K. Naturhistorischen Hofmuseums, Vienna, who was

*Contributions from the Entomological Laboratories of the University of Illinois, No. 153.

kind enough to send specimens named by Handlirsch for use in this study.*

In addition the writer is particularly indebted to the following persons for much valuable aid in preparing the paper: Professor C. L. Metcalf; Dorothy Ann Evans; Herbert H. Ross, who gave valuable aid in many ways; and Carl O. Mohr, who prepared figures 1A and 1B.

Taxonomy and Nomenclature.

Males may be distinguished by the elongate, rounding, external covering of the genitalia, females by the flap-like, sub-triangular covering.

Family Phymatidæ.

KEY TO THE NORTH AMERICAN GENERA.

Scutellum short and triangular; a small degenerate tarsus present on the forelegs.....Genus **Phymata** Latr.
Scutellum elongate, covering the wings; no tarsus on the forelegs, Genus **Macrocephalus** Swed.

Genus **Phymata** Latrielle.

KEY TO THE SPECIES.

1. Small species, 5–6.5 mm.; colors other than black and yellow or black and green..... 2
   Larger species, 6–11.5 mm.; colors of varying combinations, or almost uniformly one..... 3

*Others who loaned material and to whom the writer is deeply indebted are the following: W. J. Baerg, of the University of Arkansas; E. D. Ball, of the University of Arizona; H. G. Barber, Washington, D. C.; S. W. Bilsing, of the A. and M. College, Texas; C. S. Brimley, North Carolina Department of Agriculture; J. Chester Bradley, of Cornell University; Lawson Caesar and R. H. Ozburn, of the Ontario Agricultural College, Guelph, Canada; T. D. A. Cockerell, of the University of Colorado; Dr. Alfons Dampf, of the Mexican Department of Agriculture; J. J. Davis, of Purdue University; G. A. Dean and Roger C. Smith, of Kansas State Agricultural College; R. W. Doane, of Stanford University; C. J. Drake, of the Iowa State College; E. O. Essig, of the University of California; T. H. Frison, of the Illinois State Natural History Survey, Urbana; C. P. Gillette and S. C. McCampbell, of the Colorado Agricultural Experiment Station; R. D. Glasgow and K. F. Chamberlin, of the New York State Museum; T. L. Guyton, Bureau of Plant Industry, Harrisburg, Pennsylvania; R. W. Harned and S. W. Simmons, of the Mississippi A. and M. College; T. J. Headlee, New Jersey Agricultural Experiment Station; W. E. Hinds, of the Louisiana State University; the late J. S. Hine, of the Ohio State Museum; H. B. Hungerford, of the University of Kansas; Carl T. Schmidt, of the University of Minnesota; D. C. Mote, of the Oregon Agricultural College; P. R. Lowry, of New Hampshire Agricultural Experiment Station; H. Osborn, of Ohio State University; H. M. Parshley, Northampton, Massachusetts; H. C. Severin, South Dakota Agricultural Experiment Station; M. H. Swenk, University of Nebraska; R. S. Usinger, Oakland, California; E. P. VanDuzee, California Academy of Sciences; Harold Morrison, H. G. Barber, and J. E. Graf, of the U. S. National Museum.

2. Abdomen rather broadly rounding; points of connexiva projecting prominently; pronotum roughly finished; membrane of wings with no small round cells at the apex; Figs 13 and 14 ..... **vicina** Handl.
   Abdomen slender and tapering; points of connexiva blunt and barely projecting; pronotum almost smooth; membrane of wings with small round cells near the apex; Figs 11 and 12 ..... **luxa** n. sp.
3. With spine-like projections on the pronotum, sides of thorax, fore-femora, and elsewhere 4
   With smooth granules of varying size and in varying numbers on the above named regions 5
4. Fore-femora with granules and only a few fine spines; sides of thorax with granules rather than spines; anterior half of pronotum with short spines; lateral notch about as deep as wide, (Figs 25 and 26); occurs in Mexico ..... **granulosa** Handl.
   Fore-femora thickly covered with prominent elongate granules bearing spines; sides of thorax the same; pronotum with spines scattered on posterior half as well as the anterior; lateral notch wider than deep, (Figs 27 and 28); occurs in Arizona ..... **rossi** n. sp.
5. Membrane of wings with many rounding cells, and with the veins interwinding 6
   Membrane of wings with no round cells and the veins not interwinding 7
6. Frontal processes sharply upturned and pointed; lateral edges of pronotum rather thin and upturned; no distinct lateral notch, (Fig. 10); fourth connexivum ending in one point ..... **albopicta** Handl.
   Frontal processes rather blunt and slightly upturned; lateral edges of pronotum thick and not upturned; a distinct lateral notch, (Fig. 16); fourth connexivum three lobed, the middle one longest ... **noualhieri** Handl.
7. Pronotum, as seen from the top and also from the side, with a shallow lateral notch which appears as a slight sinuation of the edge, (Figs. 29 and 30); posterior lobe of pronotum not much raised or widened; occurs in Arizona, Colorado, Idaho, and Utah ..... **borica** n. sp.
   Pronotum with a distinct lateral notch as seen from the top and side 8
8. Species entirely deep red in color; sharp lateral process to the posterior lobe of pronotum, (Fig. 15); occurs in California ..... **arctostaphylæ** Van D.
   Species other than red in color 9
9. Posterior lobe of pronotum widely flaring and greatly upturned with long lateral point; lateral notch deep, (Figs. 17, 18, 19 and 20) 10
   Posterior lobe of pronotum moderately flaring and upturned, or not; lateral notch moderate, (Figs. 2, 3, 4, 5, 6, 7, 8, examples) 11
10. Lateral process sharply pointed and elongate; deep lateral notch, (Figs. 17 and 18); tips of connexiva only slightly projecting; occurs in Mexico, **fasciata** (Gray)
    Lateral process less sharply pointed and shorter; lateral notch not as deep, (Figs. 19 and 20); tips of connexiva more projecting; widely distributed, (see text); another form of this with more rounding posterior lobe keys down later ..... **fasciata georgiensis** Melin
11. Lateral process and posterior corner of pronotum very sharply pointed, (Figs. 23 and 24); abdomen flaring quite abruptly to the widest point; occurs in Florida, Georgia ..... **mystica** n. sp.
    Lateral process and posterior corner of pronotum moderately pointed or rounding; abdomen not flaring abruptly to the widest point 12
12. Connexiva projecting in prominent, small tips; posterior lobe of pronotum, as seen from above, and from the side, rounding or with a blunt tip, (Figs. 21 and 22); longitudinal ridges with distinct knobs towards the anterior part; widely distributed ..... **fasciata georgiensis** Melin
    Connexiva, if projecting, only forming a simple angle 13
13. Ocellar processes slender and noticeably long as seen from above, not much thicker at the base 14
    Ocellar processes short, and not strikingly noticeable as seen from above, arise from a thickened base 16

14. Terminal antennal segment of the male always longer than the preceding two united, the average one and one-third times as long; in the female the apical antennal segment is about 0.9 as long as the preceding two united; points of connexiva hardly projecting; first three connexiva rarely with a dark spot at the base; East of the Mississippi River; (Figs. 2 and 3).....**pennsylvanica** Handl.

Terminal antennal segment of the male never one and one-third times as long as the preceding two united, rarely as long as the two united, in the female much shorter; ocellar processes more developed and noticeable...15

15. Ocellar processes slender and twig-like; longitudinal ridges of pronotum hardly widening at the anterior part; pronotum from the lateral aspect as in Figs. 4 and 5; our most common form, (see distribution), **pennsylvanica americana** Melin

Ocellar processes stouter and less twig-like; longitudinal ridges of pronotum noticeably widening at the anterior part; pronotum from lateral aspect as in Figs. 6, 7, 8 and 9; a western form, (see distribution), **pennsylvanica coloradensis** Melin

16. Posterior corner of pronotum very blunt, or rounded as seen from above; lateral process of pronotum bluntly pointed, or rounded, (Figs. 31, 32, 35 and 36).....17

Posterior corner of pronotum distinctly and sharply pointed; lateral process of pronotum distinctly pointed, (Figs. 33, 34, 37, 38, 39 and 40)....18

17. Frontal processes noticeably tapering anteriorly; connexiva hardly projecting and only in blunt angles; occurs in Arizona and California; (Figs. 31 and 32).....**salicis** Ckll.

Frontal process not tapering noticeably anteriorly; connexiva projecting in distinct small points; occurs in Mexico; (Figs. 35 and 36)..**severini** Handl.

18. Membrane of wings hyaline;* color green with black markings, in older specimens the green turning into a very light buff; occurring in Oregon and British Columbia; (Figs. 33 and 34).....**metcalfi** n. sp.

Membrane of wings brown*.....19

19. Connexiva and ventral surface of abdomen with very few, if any, small granules; fore-femora with very few, if any, small granules on the outer surface; occurring in California; (Figs. 37 and 38).....**pacifica** n. sp.

Connexiva and ventral surface of abdomen with a varying number of distinct small granules; fore-femora rather thickly covered with granules on the outer surface; occurs in California; (Figs. 39 and 40), **pacifica stanfordi** n. sp.

Phymata pennsylvanica Handlirsch.

(Figs. 2 and 3.)

Phymata erosa pennsylvanica Handlirsch, Ann. K. K. Nat. Hofm., Wien, XII, 1897, p. 163.

Phymata americana newyorkensis Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 7.

This species was considered under the name *newyorkensis* by Melin who discredits Handlirsch's name *pennsylvanica* on the basis of insufficient description. According to the International Rules of Nomenclature Handlirsch's description and figure are sufficient to make his name valid. The removal of this and related forms from a subspecific position in relation to *erosa* and the demonstration by Melin that *fasciata* also

*Membrane of wings is not transparent and the color seen is that of the membrane itself and not that of the abdomen showing through it.

belongs to a species distinct from *pennsylvanica*, leaves this latter name the prior available name for the species complex to which it belongs. Melin erected the name *americana* to accommodate this species complex but *pennsylvanica* has thirty-three years priority over his name.

This subspecies may be identified from the allied ones by the long apical antennal segment. The ratio of this segment to the preceding two united, averages 1.3:1 in the male. Extremes, in a series measured, average 1.14:1 to 1.42:1 in the male. In the female this segment is noticeably longer and more slender than those of the allied subspecies. It averages 0.9:1. The abdomen is more slender than in *Phymata pennsylvanica americana* and the connexiva form an almost perfectly smooth line. Fourth connexivum is narrower, and more acutely angled than in the above named subspecies. No basal dark spots on connexiva. The specimens examined, totalling about 300, came from the following states: New York, Pennsylvania, District of Columbia, West Virginia, Ohio, Massachusetts, North Carolina, Kentucky, Georgia, Indiana, New Jersey, and Connecticut.

Phymata pennsylvanica americana Melin.

(Figs. 4 and 5.)

Phymata erosa fasciata auctt. (See VanDuzee, 1917).
Phymata americana wisconsina Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 6.
Phymata americana ottawensis Melin, *Ibid.*, p. 7.

Melin proposed the name *americana* to include a complex of four subspecies which he called *wisconsina*, *coloradensis*, *ottawensis* and *newyorkensis*. According to Article 52 of the Entomological Code, one of the subspecific names should be a repetition of the species name. One of Melin's subspecific names should therefore be changed to *americana*. Since *wisconsina* is the first subspecies described, it is taken as the typical form and *americana americana* substituted for *americana wisconsina*. Handlirsch's name *pennsylvanica*, however, applies to one of the subspecies of this group, and, since it is the prior name, supplants *americana* as the specific name of the complex. The subspecies *ottawensis* of Melin is included in this one, because the name is based only on a few individual variants.

This subspecies is characterized by the long twig-like ocellar processes in both sexes. Connexiva project in blunt points, and usually bear a small dark basal mark.

Specimens were examined from the following states: Massachusetts, New York, District of Columbia, Virginia, Delaware, New Jersey, Maryland, North Carolina, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Kansas, Nebraska, Arkansas, Colorado, and Montana. The total number of specimens examined was in excess of 1200.

Phymata pennsylvanica coloradensis Melin.

(Figs. 6, 7, 8 and 9.)

Phymata americana coloradensis Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 7.

This form differs from *pennsylvanica americana* in the following ways. Shape of the pronotum is wider, more flaring (in the typical form, Figs. 6 and 7). Ocellar processes thicker and less twig-like. Longitudinal ridges more distended anteriorly. General size larger.

There is considerable variation in the shape of the pronotum, but a graded series can be made showing the relationship. The two extremes in pronotal shape are illustrated (Figs. 6, 7, 8, 9).

The states represented in the collection were Kansas, Nebraska, Arizona, Colorado, New Mexico, Oregon, Utah, and Washington. 250 specimens were examined.

Phymata fasciata (Gray).

(Figs. 17 and 18.)

Syrtis erosa fasciata Gray, Griffith's Anim. Kingd., XV, 1832, p. 242.
Phymata fasciata mexicana Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 10.

Melin has demonstrated in his recent work that *P. erosa* is a distinct type and limited to Surinam and the nearby territory. He then proposes that *fasciata* Gray become a species complex, and names two subspecies under it, *fasciata georgiensis* and *fasciata mexicana*. According to Article 52 of the Entomological Code, one of the subspecific names should be a repetition of the species name. One of Melin's subspecific names should therefore be changed to *fasciata*. It so happens that the specimens examined from the K. K. Naturhistorischen Hofmuseums, Vienna, and bearing Handlirsch's determination are the subspecies called *mexicana* by Melin. Hence the name *fasciata* is the prior name for this subspecies.

This subspecies is characterized by the flaring pronotum with a sharp, pointed, lateral process, the deep lateral notch (Figs. 17 and 18), the wide, spreading abdomen, and the distribution, which is restricted to Mexico. Eleven specimens were examined, all from Mexico.

Phymata fasciata georgiensis Melin.

(Figs. 19, 20, 21 and 22.)

Phymata erosa fasciata auctt. (See VanDuzee, 1917).
Phymata fasciata georgiensis Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 9.

This subspecies may be differentiated from *fasciata* Gray by the pronotum, which is not as flaring, and which has a blunt lateral process, or one which is rounding (Figs. 19, 20, 21 and 23). The lateral notch is slightly smaller, and the abdomen is narrower throughout. This subspecies is quite variable, and certain forms may eventually be separated into another subspecies, but further study is desirable before such a step is taken.

The distribution of this subspecies is quite surprising. Specimens studied came from the following states: District of Columbia, New Jersey, Maryland, Virginia, North Carolina, Georgia, Florida, Louisiana, Mississippi, Ohio, Illinois, Missouri, Nebraska, Kansas, Arkansas, Oklahoma, Texas, and New Mexico. About 385 specimens were examined.

Phymata mystica new species.

(Figs. 23 and 24.)

MALE:

Size and General Color.—Length of body, 7.5 to 8.5 mm. Width of pronotum, 3 to 3.6 mm. Ground color black or dark brown with a contrasting yellow or buff. Head either entirely black with buff colored antennae, or entirely buff colored, or buff with a black basal region. Pronotum either black or varying shades of brown, with the lighter colors at the anterior corners and a light margin along the lateral notch. Sides of thorax either entirely black or brown, or with a combination of these colors. Legs greenish yellow to buff, with no markings. The forelegs may sometimes be darker than the second and third pairs. Scutellum similar to the pronotum. Corium dark or a lighter shade of brown with a cross band of lighter color. Membrane brown. Abdomen entirely yellow or buff except for a black or dark brown transverse band on the fourth and basal half of the fifth segments, and a corresponding mark at the apex, which may extend completely across the tip, or be only a spot on either side.

Head and Antennae.—Frontal processes extending slightly beyond the first antennal segment, and usually rather sharply pointed. Dorsally the head narrows slightly toward the tip. Ocellar processes short

and blunt. Preocellar processes indistinct. Surface of head studded with small smooth granules. Antennae with the terminal segment almost as long as the preceding two united. The ratio is 0.9 to 1.

Thorax and Appendages.—Pronotum with almost no granulation but roughened. Anterior lobe slightly rounding. Lateral notch rather deep and narrow. Posterior lobe greatly raised and with two very sharp and distinct points (Figs. 23 and 24). Longitudinal ridges slightly raised, narrow, and with a distinct raised knob at the anterior at the highest point. Sides of thorax with very few granules, those present being mainly along the edges and at the antennal groove. Legs rather strikingly smooth. Corium without any granules. Scutellum with a vein and a distinct median ridge.

Abdomen strikingly widened with the corners of the first three connexiva sharply projecting, and the fourth acutely angled and much wider. Fifth connexivum almost as wide as the fourth. Fifth and sixth segments forming a rather wide and short apex to the abdomen. Abdomen almost devoid of granules, those found being inconspicuous and scattered.

FEMALE:

Length, 8.5 to 10 mm. Width of pronotum, 3.5 to 4.2 mm. Color as in the male but lighter. Terminal antennal segment about three-fourths as long as the preceding two united. Otherwise as in the male.

Holotype.— ♂, Dunedin, Florida, April 12, 1915 (W. S. Blatchley). Deposited in the collection of the Illinois State Natural History Survey, Urbana.

Allotype.— ♀, Leesburg, Florida, Sept. 10, 1930 (C. Goff). Deposited with the holotype.

Paratypes.—5 ♂♂, 5 ♀♀, Dunedin, Florida, Oct. 23–30, 1914 (Blatchley); 3 ♂♂, 3 ♀♀, Jacksonville, Florida; 5 ♂♂, 1 ♀, Florida; 1 ♂, 1 ♀, Billy's Island, Okefenoke Swamp, Georgia, June, 1912; 1 ♂, 2 ♀♀, Gainesville, Florida, July 7–28, 1918 (C. J. Drake); 2 ♀♀, Tampa, Florida, Fall 1927 (C. O. Bare); 2 ♂♂, Ft. Myers, Florida, April 1, 1922 (J. N. Knull) and March 31, 1912 (H. G. Barber); 1 ♂, Cleveland, Florida, April, 1925 (J. N. Knull); 1 ♀, same locality, April, 1927 (D. M. DeLong); 1 ♂, 2 ♀♀, Leesburg, Florida, Sept. 10, 1930 (C. Goff); 1 ♂, Punta Gorda, Florida, Nov. 13, 1911 (Wm. T. Davis), 1 ♀, Waynesville, Georgia, Sept. 10, 1909; 1 ♀, St. Augustine, Florida (C. T. Brues); 1 ♂, Miami, Florida (J. C. Hamlin); 1 ♀, Orlando, Florida, April, 1929 (D. M. DeLong); 2 ♂♂, Miami, Florida, Nov. 3, 1912; 2 ♂♂, Orlando, Florida, May 21, 1922 (H. E. Ewing) and Aug. 23, 1907 (Russell). Distributed in the collections of Cornell University; Purdue University; Agricultural Experiment Station, Fort Collins,

Colorado; H. M. Parshley; Bureau of Plant Industry, Harrisburg, Pennsylvania; H. G. Barber; Iowa State College; University of California; University of Kansas; Agricultural Experiment Station, Tucson, Arizona; U. S. National Museum; and the author.

This species is allied to *P. fasciata georgiensis* Melin and can be separated from it by the following characters. Abdomen flaring more abruptly to the widest point, and more rounding to the apex. Projecting tips of connexiva shorter and not as sharply pointed. Posterior lobe with a sharp pointed lateral process and posterior corner. A short deep curve leading from the lateral process to posterior corner. Longitudinal ridges narrower and with a smaller knob at the anterior end. Colors black and yellow rather than a reddish brown and yellow as found in *georgiensis*.

This species has been named *P. guerini* by previous American authors, but is not the *guerini* of Handlirsch. Specimens of the true *guerini* named by Handlirsch and coming from the typic locality, Cuba, differ very markedly from *mystica*.

Phymata arctostaphylæ VanDuzee.

(Fig. 15.)

Phymata erosa arctostaphylæ VanDuzee, Trans. San Diego Soc. Nat. Hist., 2, 1914, p. 11.

This species is being raised from a subspecies of *erosa*, because of Melin's discussion of that form. It appears as a distinct species being distinguished by the upright posterior pronotal lobes with sharp, long, lateral processes, the sharp, posterior corner, very small lateral notch, and the thin, rather sharply raised, longitudinal ridges (Fig. 15). The sharply projecting and acutely angled fourth connexiva are similar to *P. mystica*, which is probably the most closely allied species but it can be distinguished by the above characters and the striking red color which VanDuzee states is diagnostic.

One specimen from California sent to me by Professor E. P. VanDuzee.

Phymata granulosa Handlirsch.

(Figs. 25 and 26.)

Phymata erosa granulosa Handlirsch, Ann. K. K. Hofm., Wien, XII, 1897, p. 163.
Phymata granulosa Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 15.

This species is most closely allied to *P. rossi*, but has fewer spines, and these are limited mainly to the anterior half of

the pronotum, and with a relatively few on the fore-femora. The sides of the thorax are granular, rather than spiny, and the edges of the pronotum and abdomen are not as sharply toothed. The lateral notch is larger and the posterior lobe is more sharply raised and pointed (Figs. 25 and 26).

Twenty specimens were examined, all from Mexico.

Phymata rossi new species.

(Figs. 27 and 28.)

MALE:

Size and General Color.—Length of body, 7 to 8 mm. Width of prothorax, 2.9 to 3 mm. Head dark brown and black on top, light brown on the sides. Antennae same as the sides, with the terminal segment slightly darker, and with a distinct sheen present. Pronotum varying shades of brown, the darkest being found at the tips of the posterior lobe. Scutellum a medium brown. Sides of thorax light brown. Legs the same color except the femora, which are a reddish brown. Hemelytra dark with a very pale band across the middle. Membrane brown. First, second and third connexiva yellowish, fourth and basal half of fifth black, the remaining connexiva yellow except for a dark spot on either side of the last segment. Ventral surface of abdomen yellowish except for a continuation of the dark fourth and fifth connexiva, which extends slightly upon the abdomen.

Head and Antennae.—Frontal processes upturned, usually projecting slightly beyond the first antennal segment and with a small notch between them. Ocellar processes medium in length, with several branches. Preocellar processes small and branching. Head covered with small spines on all the surface. Antennae with the terminal segment about as long as the preceding two taken together.

Thorax and Appendages.—Anterior half of pronotum with many spine-like projections, the posterior half with scattered ones. These also occur along the edges, producing a toothed effect. Anterior lobe gently widening. Lateral notch long and shallow (Figs. 27 and 28). Posterior lobe with distinct, sharp lateral processes and sharp posterior corners. Longitudinal ridges slender and only slightly raised. Sides of thorax with many of the spines found above, these also continuing on the coxae, trochanters and femora of all the legs, outer surface of the front femora thickly covered with them, those on the femora of the other legs in rows along each edge. Corium of the wings with a few scattered spines. Scutellum with a narrow, sharp margin trimmed with small spines. The cross-shaped center design is also studded with these spines.

Abdomen.—Edges of connexiva with spines similar to edges of pronotum but to a lesser degree. Posterior corners of first three connexiva projecting in small sharp points. The fourth also projects slightly and sharply. There is a gradual widening of the abdomen to the widest point. The dorsal and ventral surfaces have small granules and a few very small scattered spines.

FEMALE:

Length, 8 to 9 mm. Width of pronotum, 3 to 3.5 mm. Color as in the males, but with the dark colors replaced by a lighter brown. Terminal segment of antennae a little longer than the third segment. Abdomen more rounding. Otherwise as in the male.

Holotype.— ♂, Huachaca Mts., Arizona, August 8, 1927 (R. H. Beamer). Deposited in the collection of the University of Kansas, Lawrence.

Allotype.— ♀, same data as the holotype.

Paratypes.—2 ♀ ♀, same data as holotype and allotype; 1 ♀, Huachaca Mts., Arizona, July 28, 1907; 2 ♂ ♂, 2 ♀ ♀, Santa Rita Mts., Arizona, June-July (F. H. Snow); 4 ♂ ♂, 1 ♀, Arizona; 1 ♂, 1 ♀, Yavapai Co., Arizona, August 9, 1927 (P. A. Readio); 1 ♀, Zion Natl. Park, Utah, Aug. 13, 1929 (R. H. Beamer); 1 ♂, West side of Organ Mts., New Mexico, July (E. O. Wooton). Deposited in the collections of the University of Kansas, Lawrence; Cornell University, Ithaca, New York; Ohio State University; Stanford University, Palo Alto, California; Iowa State College, Ames; and the author.

This species is most closely related to *P. granulosa* Handlirsch but is slightly smaller, and has the spine-like projections more generally scattered over the entire body. The forelegs are more thickly covered with setiferous granules. The lateral notch is smaller in both directions, and the posterior lobe is not as sharply raised or pointed.

Phymata borica new species.

(Figs. 29 and 30.)

MALE:

Size and General Color.—Length, 8 mm. Width of pronotum, 2.8–3 mm. Color: Basal part of the head black or dark brown, the rest a medium brown. Antennae medium brown with the terminal segment darker. Sides of head and all of the ventral parts a greenish yellow. In older specimens this is more of a reddish brown. Pronotum is somewhat mottled with black, brown, and buff. Scutellum a light yellow or brown. Corium dark brown with light band. Under the wings a dark design is found. Abdomen mainly a greenish yellow with the usual dark band on all of the fourth, and the basal half of the fifth connexiva. First, second, and third connexiva may have a small dark spot at the basal edge, or not. There is a small dark spot on each side of the sixth connexivum. These dark areas show on the ventral surface.

Head and Antennae.—Frontal processes may extend slightly beyond the first antennal segment, or not. Notch between them may be distinct, or may be obliterated. Ocellar processes distinct and stout.

Preocellar processes small and indistinct. Terminal segment of antennae almost as long as the preceding two united. Median part of the dorsal surface of the head almost smooth, the rest of the head with fine granules.

Thorax and Appendages.—Pronotum characterized by the subquadrate shape. Lateral notch very small, and the posterior lobe hardly raising or flaring (Figs. 29 and 30). Lateral process blunt or slightly pointed. Posterior corner distinct. Longitudinal ridges almost smooth, a few granules at the anterior end. They are only slightly raised. Granulation on the pronotum is slight, and limited to the median part of the anterior lobe. On the sides of the thorax the granulation is variable and the granules small. Femora of forelegs almost smooth, a row of small granules occurring on the upper edge. Coxae and trochanters of all legs slightly granular. Femora of the middle and hind legs with a row of small granules on the upper and lower edges. Scutellum as wide as long, with a narrow rim. The raised central area with scattered granules.

Abdomen gently tapering to widest point. The connexiva almost even or only slightly projecting. The fourth connexivum only slightly projecting, and in some specimens somewhat rounded.

FEMALE:

Length, 8.5 to 9 mm. Width of pronotum, 3 to 3.5 mm. Colors lighter than in the male. Abdomen somewhat more rounding. Terminal antennal segment about three-fourths as long as the preceding two united. Otherwise as in the male.

Holotype.—♂, Zion National Park, Utah, July 13, 1929 (R. H. Beamer). Deposited in the collection of the University of Kansas, Lawrence.

Allotpye.—♀, Chiric Mts., Arizona. Deposited in the collection of Cornell University, Ithaca, New York.

Paratypes.—2 ♂♂, 3 ♀♀, same data as allotype, two of them dated September 6, 1897; 1 ♀, Arizona (C. F. Baker); 2 ♂♂, Pocatella, Idaho; 1 ♂, Arizona, August, 1902 (F. H. Snow); 2 ♂♂, Glenwood Springs, Colorado (Wickham); 1 ♂, Dixie, Utah, September 10, 1915 (E. D. Ball). Distributed in the collections of Cornell University; University of Kansas; U. S. National Museum; University of Nebraska; H. G. Barber; Agricultural Experiment Station, Tucson, Arizona; and the author.

This species might be confused with some forms of *P. pennsylvanica coloradensis* but can be separated from them by the smaller size; the more reddish brown color; the flattened pronotum with a very small lateral notch; and the shorter, thicker ocellar processes.

Phymata salicis Cockerell.

(Figs. 31 and 32.)

Phymata erosa salicis Cockerell, Entomologist, XXXIII, 1900, p. 66.

On the basis of Melin's discussion of *P. erosa* L. this subspecies is being raised to specific rank. The closest allied form observed is *P. metcalfi* (Figs. 33 and 34). *P. salicis* Cockerell may be distinguished from this allied form by the more rounding posterior lobe, and the more open lateral notch of the pronotum (Figs. 31 and 32), and by the longer and more pointed frontal processes of the head.

Thirty specimens were examined, all from Arizona and California.

Phymata metcalfi new species.

(Figs. 33 and 34.)

MALE:

Size and General Color.—Length, 7.5 to 8 mm. Width of pronotum, 2.8 to 3 mm. Color in specimens collected July 28, 1930, as follows: Head greenish with black ocellar processes and base, and a dark margin. Antennae greenish with the terminal segment brownish. Sides and front of head light brown. Pronotum greenish and marked with dark brown or black. The greenish color forming a margin across the anterior part and along the sides, where it is stopped by an oblique dark band on the anterior lobe. Lateral notch margined by green. Posterior lobe dark except near the lateral notch and just in front of the scutellum. Longitudinal ridges and an area on each side, greenish. Lateral aspect buff with the legs brown or greenish. The green shows up particularly on the second and third pairs of legs and on the tibiae of the forelegs. Scutellum light green. Corium brownish on the basal half with the rest pale green. Abdomen light brown with a dark band on the fourth and the basal part of the fifth connexiva. This continues over the edge and is found ventrally on the connexiva. Remainder of the abdomen, ventrally, is light buff or yellowish. In older specimens the green has faded into a yellowish-brown, and the darker parts have become correspondingly lighter in color.

Head and Antennae.—Frontal processes more or less blunt and projecting slightly beyond the first antennal segment. The notch between them varies considerably, but is usually rather shallow. Ocellar processes quite long and distinct. Preocellar processes also distinct but shorter. Terminal segment of antennae about 0.8 as long as the preceding two taken together.

Thorax and Appendages.—Pronotum with a few very small granules located mainly on the anterior lobe. Anterior lobe gently rounding to the lateral notch, which is rather small both in length and depth. Posterior lobe with a distinct lateral process and posterior corner (Figs. 33 and 34). Longitudinal ridges slightly raised and enlarging very little at the anterior part. Sides of the thorax with very few

Preocellar processes small and indistinct. Terminal segment of antennae almost as long as the preceding two united. Median part of the dorsal surface of the head almost smooth, the rest of the head with fine granules.

Thorax and Appendages.—Pronotum characterized by the subquadrate shape. Lateral notch very small, and the posterior lobe hardly raising or flaring (Figs. 29 and 30). Lateral process blunt or slightly pointed. Posterior corner distinct. Longitudinal ridges almost smooth, a few granules at the anterior end. They are only slightly raised. Granulation on the pronotum is slight, and limited to the median part of the anterior lobe. On the sides of the thorax the granulation is variable and the granules small. Femora of forelegs almost smooth, a row of small granules occurring on the upper edge. Coxae and trochanters of all legs slightly granular. Femora of the middle and hind legs with a row of small granules on the upper and lower edges. Scutellum as wide as long, with a narrow rim. The raised central area with scattered granules.

Abdomen gently tapering to widest point. The connexiva almost even or only slightly projecting. The fourth connexivum only slightly projecting, and in some specimens somewhat rounded.

FEMALE:

Length, 8.5 to 9 mm. Width of pronotum, 3 to 3.5 mm. Colors lighter than in the male. Abdomen somewhat more rounding. Terminal antennal segment about three-fourths as long as the preceding two united. Otherwise as in the male.

Holotype.—♂, Zion National Park, Utah, July 13, 1929 (R. H. Beamer). Deposited in the collection of the University of Kansas, Lawrence.

Allotpye.—♀, Chiric Mts., Arizona. Deposited in the collection of Cornell University, Ithaca, New York.

Paratypes.—2 ♂♂, 3 ♀♀, same data as allotype, two of them dated September 6, 1897; 1 ♀, Arizona (C. F. Baker); 2 ♂♂, Pocatella, Idaho; 1 ♂, Arizona, August, 1902 (F. H. Snow); 2 ♂♂, Glenwood Springs, Colorado (Wickham); 1 ♂, Dixie, Utah, September 10, 1915 (E. D. Ball). Distributed in the collections of Cornell University; University of Kansas; U. S. National Museum; University of Nebraska; H. G. Barber; Agricultural Experiment Station, Tucson, Arizona; and the author.

This species might be confused with some forms of *P. pennsylvanica coloradensis* but can be separated from them by the smaller size; the more reddish brown color; the flattened pronotum with a very small lateral notch; and the shorter, thicker ocellar processes.

Phymata salicis Cockerell.

(Figs. 31 and 32.)

Phymata erosa salicis Cockerell, Entomologist, XXXIII, 1900, p. 66.

On the basis of Melin's discussion of *P. erosa* L. this subspecies is being raised to specific rank. The closest allied form observed is *P. metcalfi* (Figs. 33 and 34). *P. salicis* Cockerell may be distinguished from this allied form by the more rounding posterior lobe, and the more open lateral notch of the pronotum (Figs. 31 and 32), and by the longer and more pointed frontal processes of the head.

Thirty specimens were examined, all from Arizona and California.

Phymata metcalfi new species.

(Figs. 33 and 34.)

MALE:

Size and General Color.—Length, 7.5 to 8 mm. Width of pronotum, 2.8 to 3 mm. Color in specimens collected July 28, 1930, as follows: Head greenish with black ocellar processes and base, and a dark margin. Antennae greenish with the terminal segment brownish. Sides and front of head light brown. Pronotum greenish and marked with dark brown or black. The greenish color forming a margin across the anterior part and along the sides, where it is stopped by an oblique dark band on the anterior lobe. Lateral notch margined by green. Posterior lobe dark except near the lateral notch and just in front of the scutellum. Longitudinal ridges and an area on each side, greenish. Lateral aspect buff with the legs brown or greenish. The green shows up particularly on the second and third pairs of legs and on the tibiae of the forelegs. Scutellum light green. Corium brownish on the basal half with the rest pale green. Abdomen light brown with a dark band on the fourth and the basal part of the fifth connexiva. This continues over the edge and is found ventrally on the connexiva. Remainder of the abdomen, ventrally, is light buff or yellowish. In older specimens the green has faded into a yellowish-brown, and the darker parts have become correspondingly lighter in color.

Head and Antennae.—Frontal processes more or less blunt and projecting slightly beyond the first antennal segment. The notch between them varies considerably, but is usually rather shallow. Ocellar processes quite long and distinct. Preocellar processes also distinct but shorter. Terminal segment of antennae about 0.8 as long as the preceding two taken together.

Thorax and Appendages.—Pronotum with a few very small granules located mainly on the anterior lobe. Anterior lobe gently rounding to the lateral notch, which is rather small both in length and depth. Posterior lobe with a distinct lateral process and posterior corner (Figs. 33 and 34). Longitudinal ridges slightly raised and enlarging very little at the anterior part. Sides of the thorax with very few

granules, these occurring mainly along the edges of the sclerites. Legs with few scattered granules, the fore-femora smooth on the side, and with a row of small knobs on the upper edge. Scutellum with a thin, sharp, margin, and with the center design granular on the raised portions.

Abdomen with small scattered granules on the upper and lower surfaces. Tapering gently to the widest point. First three connexiva extending very slightly at the posterior corner, or not at all. The fourth extending in an acute point.

FEMALE:

Length, 8.2 to 9 mm. Width of pronotum, 3 to 3.5 mm. Color a light green, or yellowish in older specimens, over the entire body. The darker markings are not as prominent as in the males. Fourth segment of antennae about seven-tenths as long as second and third united. Otherwise as in the male.

Holotype.— ♂, Summer Lake, Lake Co., Oregon, July 28, 1930 (H. A. Scullen). Deposited in the collection of the Oregon Agricultural College, Corvallis, Oregon.

Allotype.— ♀, same data as holotype.

Paratypes.—3 ♂ ♂, 1 ♀, same data as holotype and allotype; 1 ♂, 2 ♀ ♀, Ione, Oregon, Aug. 12 (Currin); 2 ♂ ♂, 1 ♀, Umatilla, Oregon, July 21, 1914 (H. F. Wilson); 1 ♂, 1 ♀, Lillooett, B. C., October 2, 1918. Deposited in the collections of the Oregon Agricultural College, Corvallis; H. M. Parshley, Northampton, Massachusetts; and the author.

This species resembles *P. salicis* Cockerell but can be differentiated from it by the more pointed and sharply upturned posterior lobe of the pronotum, by the less sharply pointed and less projecting frontal processes, the shorter lateral notch, the wider prothorax and abdomen, and the longer fourth antennal segment.

Phymata severini Handlirsch.

(Figs. 35 and 36.)

Phymata erosa severini Handlirsch, Ann. K. K. Nat. Hofm., Wien, XII, 1897, p. 164.
Phymata severini Handlirsch, Melin, Arkiv for Zoologi, Band 22A, No. 2, October 8, 1930, p. 8.

This species is closely allied to *P. pacifica* but may be separated from the two subspecies in that group by the following characters. Pronotum as seen from above has rounding or very bluntly pointed posterior lobes (Figs. 35 and 36), whereas in *pacifica* the lateral process is distinctly pointed. Anterior lobe is somewhat more rounding laterally than in *pacifica*.

Tips of connexiva project more distinctly and in small points. Edges of last three connexiva somewhat sinuate, in *pacifica* broadly rounding. Six specimens were studied, all from Mexico.

Phymata pacifica new species.
(Figs. 37 and 38.)

MALE:

Size and General Color.—Length, 6.5 to 7.5 mm. Width of pronotum, 2.8 to 3 mm. Color in specimens collected in 1929 as follows: Base of head to, and including the ocellar processes, dark brown or black studded with light colored granules. Remainder of head usually a pale cream color, in some a tinge of brown on the dorsal surface. Antennae with the first three segments pale, and the fourth varying shades of brown, but darker than the others. Anterior lobe of pronotum pale cream color, except for a small brown spot on the middle of the edges. Posterior lobe with this same light color along the margins reaching nearly to the lateral process. The posterior margin is also light, as is the entire scutellum. Remainder of pronotum, dorsally, is a reddish brown. Sides of the thorax, and the appendages, are similar to the sides of the head. Corium medium brown with a band that is paler and pinkish. Membrane is brown. Abdomen is yellow-buff, except for a reddish brown band on the fourth and basal half of the fifth connexiva. This band extends underneath a short distance.

Head and Antennae.—Head covered with many small, light colored granules. Frontal processes extend slightly beyond the first antennal segment, and are upturned. From the dorsal aspect, they have a sharp, angular notch between them, and are slightly rounding on the lateral edges. Ocellar processes short and rather heavy. Preocellar processes small, their light color making them indistinct. Fourth segment of antennae 0.8 to 0.9 as long as the second and third together.

Thorax and Appendages.—Pronotum granulate on the anterior lobe, and weakly punctate on the posterior lobe. Anterior lobe rounding, posterior lobe with sharp lateral process, and distinct posterior corner (Figs. 37 and 38). Longitudinal ridges thin, but distinct; slightly granular on the anterior tip. Sides are quite granulate, with small granules, but the appendages are practically devoid of any. Scutellum with a thin rim, the raised portion in the inner part is irregularly granulate.

Abdomen almost smooth, a very few scattered granules being present. Tapers gradually to the widest point. Posterior points of the first three connexiva projecting slightly, and bluntly. Fourth connexiva continuing the line of the first three. Ventral surface is somewhat shiny and with a few very small granules.

FEMALE:

Length, 7.3 to 8 mm. Width of pronotum, 3 to 3.5 mm. Color as in the male, except that the darker areas as found in the male are paler in this sex. Fourth segment of antennae about six-tenths to seven-tenths as long as 3 and 2 united. Otherwise as in the male.

Holotype.— ♂, San Diego Co., California, July 4, 1929 (R. H. Beamer). Deposited in the collection of the University of Kansas, Lawrence.

Allotype.— ♀, Alpine, California, July 9, 1929 (R. H. Beamer). Deposited with holotype.

Paratypes.—1 ♂, same data as holotype; 1 ♂, 1 ♀, same data as allotype; 1 ♂, San Jacinto Mts., California, July 21, 1929 (R. H. Beamer); 2 ♂♂, 1 ♀, Sonoma Co., California; 1 ♂, San Francisco, California; 1 ♂, Los Angeles Co., California; 1 ♂, Bakersfield, California, August 19–20, 1917 (R. C. Shannon); 1 ♂, 1 ♀, Claremont, California (Baker); 1 ♀, Orange Co., California; 1 ♂, 1 ♀, Tamalpias, California, August 5, 1915 (VanDuzee); 1 ♀, Coahuila, San Diego Co., California, August 18, 1914 (J. C. Bradley); 1 ♀, Ontario, California; 2 ♀♀, San Mateo Co., California; 1 ♀, California; 4 ♂♂, 9 ♀♀, Auburn, California, August 1915 and 1916 (L. Bruner); 1 ♂, 1 ♀, Tamalpais, California; 1 ♀, Giant Forest, California, July 28, 1929 (R. H. Beamer); 2 ♂♂, 1 ♀, San Margarita, California, August 6, 1912 (E. D. Ball); 1 ♂, 1 ♀, Orange Co., California, July 14, 1929 (R. H. Beamer); 1 ♂, Southern California; 1 ♀, Orange Co., California (E. O. Essig). Deposited in the collections of the University of Kansas; Ohio State University; Cornell University, Ithaca, New York; University of Nebraska; H. M. Parshley; Agricultural Experiment Station, Tucson, Arizona; Stanford University; University of California; Agricultural Experiment Station, Ft. Collins, Colorado; R. L. Usinger; and the author.

This species is allied to *P. severini* Handlirsch but differs in having sharper points to the posterior lobe of the pronotum and a more rounding abdomen, which does not taper as much in the last three segments as does *severini*. Prosternal processes are finer. Top of head has a rougher appearance.

Phymata pacifica new subspecies **stanfordi.**

(Figs. 39 and 40.)

MALE:

Size and General Color.—Length, 6.8 to 7.8 mm. Width of pronotum, 2.5 to 3 mm. Color: Head black or dark brown from the base to the ocellar processes and a marginal black line to the tips of the frontal processes. Center part light brown. Antennae light reddish brown for the first three segments, the fourth being darker. Pronotum chiefly a light buff with black markings on the edge of the

anterior lobe about the center, and the edge of the posterior lobe. Sides of the head and thorax a light buff with a reddish tinge. Appendages the same, except the tibiae of the forelegs and the tarsi of all of them, which are green. Scutellum a light buff. Corium a medium brown for the basal half and lighter the rest of the distance. Abdomen only slightly darker than the pronotum for the most part. Fourth connexivum darker, with a light spot, sometimes elongating into a streak, on it. Basal part of fifth connexivum dark. A dark spot on each side of the last connexivum. Ventrally, the abdomen is about the same color as the fore part, but sometimes shows a slightly redder tinge. The dark markings on the fourth, fifth and sixth connexiva show underneath also. In older specimens the customary fading takes place, green showing yellow, and browns becoming lighter and more yellowish.

Body and Appendages as in *pacifica*, the outstanding difference being in the amount of granulation on the dorsal and ventral surfaces. In this subspecies the granulation is noticed readily, particularly from the lateral aspect, and is shown markedly on the forelegs, as well as the others, and on the ventral surface of the abdomen. Coloration is markedly different, in *pacifica* the light areas being a pale cream color, while in this one those areas are a light buff.

Holotype.— ♂, Stanford University, California, August 29, 1928 (Carl Duncan). Deposited in the collection of Stanford University.

Allotype.— ♀, same locality and collector as holotype. August 18, 1930.

Paratypes.—6 ♂ ♂, 6 ♀ ♀, same locality as holotype and allotype September, 1897 (Johnson), August 4 and 13, 1928, September 1, 1929, August 23–25, 1930 (Carl Duncan), and June, 1920; 3 ♀ ♀, Palo Alto, California, September, 1929 (T. Zschakke); 3 ♂ ♂, Santa Rosa, California, July, August, September, 1899; 3 ♀ ♀, Oakland Recreation Camp, California, July 20, 1928 (R. L. Usinger); 1 ♂, 1 ♀ Laguna Mts., California, July 6, 1929 (P. W. Oman); 1 ♂, 1 ♀, Santa Clara, California; 1 ♀, Mariposa Co., California, June 17, 1914; 1 ♂, Santa Cruz Mts., California; 1 ♂, Sacramento, California; 1 ♂, Mt. View, California; 1 ♂, Walnut Creek, California, July 1, 1927 (R. L. Usinger). Distributed in the collections of Stanford University; Agricultural Experiment Station, Tucson, Arizona; Iowa State College; University of California; University of Kansas; Oregon Agricultural College; Ohio State University; R. L. Usinger; and the author.

Phymata albopicta Handlirsch.

(Fig. 10.)

Phymata albopicta Handlirsch, Ann. K. K. Hofm., Wien, XII, 1897, p. 151.

This small species may be told by the flaring abdomen with the first to third connexiva extending in distinct knobs, the fourth widely extending, and the wing membrane having many small closed cells.

Only two specimens were represented, both from Mexico.

Phymata noualhieri Handlirsch.

(Fig. 16.)

Phymata noualhieri Handlirsch, Ann. K. K. Nat. Hofm., Wien, XII, 1897, p. 153.

This species differs from any other North American form studied, and can be recognized by the thick pronotum which is not raised along the edges and is only slightly wider behind than at the front; by the three-lobed fourth connexivum, with the middle lobe the largest; and by the interweaving veins of the membrane, forming closed cells of various sizes.

Five specimens were studied from the following states: North Carolina, Georgia, Florida, and Arizona.

Phymata vicina Handlirsch.

(Figs. 13 and 14.)

Phymata vicina Handlirsch, Ann. K. K. Nat. Hofm., Wien, XII, 1897, p. 150.

This species is allied to *P. luxa* and can be distinguished from the latter form by the color combination of black and white. The veins in the wing membrane are very numerous and fine and do not form closed cells towards the apex as they do in *P. luxa*.

The states from which representatives observed occurred were: Massachusetts, Connecticut, New Jersey, Virginia, Illinois, South Dakota, Nebraska, Kansas, Texas, Arizona, Colorado, Utah, and California. Thirty-five specimens were studied.

Phymata luxa new species.

(Figs. 11 and 12.)

MALE:

Size and General Color.—Length, 5 to 5.6 mm. Width of pronotum, 1.6 to 2 mm. Head mostly brown, medium on top, usually somewhat lighter on the sides. There may be a black mark at the base of the head, and the antennal groove may be black. Antennae the same color as the sides of the head and thorax. Pronotum mottled with two shades of brown, one medium, the other lighter. Scutellum medium brown. Sides of thorax light buff in some, and a reddish brown in

others. Legs same as the sides, the middle and hind femora sometimes mottled with darker. Corium somewhat variable, being a mixture of medium or darker brown with a very pale, almost white color, which may appear as a band, as a mottling, or as the color of the entire basal half. In all variations there are small whitish granules scattered in varying numbers over the corium. Abdomen varies from an almost white or cream color to a buff as the basic color. It is marked with the customary band on connexiva four and five, and has small dark spots along the edges of the connexiva. Underside of the abdomen about the same as the thorax, sometimes lighter.

Head and Antennae.—Frontal processes bluntly rounding, with a distinct notch between them. They extend distinctly beyond the first antennal segment. Ocellar processes appear as rather thick, granular swellings. Preocellar processes are difficult to observe from the dorsal aspect, but from the side they can be seen as small, almost flat structures. Terminal segment of antennae as long or slightly longer than the preceding two united. The head is quite thickly covered with granules.

Thorax and appendages.—Pronotum with no lateral notch, and without a distinct flare in the posterior part (Figs. 11 and 12). The anterior corners rather long and sharp, the lateral process distinct but blunt, and the posterior corners blunt or sharp. Longitudinal ridges only slightly raised, and smooth, except for a few granules at the anterior end. Very few granules on the pronotum and most of them in the middle of the anterior half. Posterior half rather coarsely punctate. Corium with a varying number of small whitish granules scattered over the surface. Membrane with a varying number of closed cells toward the apex. Sides of the thorax irregularly granulate. Coxae and trochanters of all the legs somewhat granulate. Fore-femora and tibiae smooth, the femora of the middle and hind legs with a row of conspicuous granules on the upper and lower edges. Fore-femora appear quite thin. Scutellum with a thin margin trimmed irregularly with small granules on the outer edges. Central raised portion with a distinct raised ridge, and irregularly granulose.

Abdomen tapering gently to the widest part. The first three connexiva with small, knob-like projections at the posterior corners. The fourth projecting slightly and bluntly pointed.

FEMALE:

Length, 6.2 mm. Width of pronotum, 2.2 mm. Colors somewhat lighter; the terminal antennal segment three-fourths as long as the preceding two united; abdomen more rounding. Otherwise as in the male.

Holotype.—♂, Del Rio, Texas, June 22, 1927 (Wickham). Deposited in the collection of the Ohio State University, Columbus.

Allotype.—♀, Colorado. Deposited in the collection of the Colorado Agricultural College, Fort Collins.

Paratypes.—1 ♂, Colorado; 1 ♂, Huachaca Mts., Arizona, June 15, 1930 (E. D. Ball); 1 ♂, San Rita Mts., Arizona, June 11, 1930 (E. D. Ball). Distributed in the collections of the Arizona Agricultural Experiment Station, Tucson; Colorado Agricultural Experiment Station, Fort Collins; and the author.

This species is most closely related to *P. vicina* Handlirsch but is more slender, smaller, and the points of the connexiva much less projecting. The closed cells in the wing membrane are also distinctive. The abdomen is more tapering than in *vicina*.

Genus **Macrocephalus** Swederus.

KEY TO SPECIES.

1. Small species, 6.5 mm. or less in length 2
   Larger species, 7 mm. or more in length 4
2. Scutellum coarsely punctured over the entire surface 3
   Scutellum coarsely punctured on the basal third, the remainder much more finely punctured; conspicuous spine-like granules on the pronotum, sides of thorax, fore-femora, and elsewhere; occurring in Arizona, **uhleri** Handl.
3. Anterior half and lateral edges of pronotum with distinct pointed granules; color in male a mottling of black and yellowish on the scutellum, female less so, and often with no dark patches; occurring in Mexico . . **stali** Handl.
   Anterior half and lateral edges of pronotum with small round granules; color on the scutellum of male may be yellow with a black median stripe, or only yellow, female usually without the black stripe; widely distributed ..... **prehensilis** (Fabr.)
4. A prominently raised knob or elevation at the anterior end of each longitudinal ridge; a prominent somewhat punctate subtriangular or arrow-shaped callus on the scutellum; color mottled dark and light; occurring in California ..... **barberi** n. sp.
   Longitudinal ridges with very small knobs or none; callus of scutellum of various shapes 5
5. Callus of scutellum sub-triangular or arrow-shaped and quite thickly punctate with very small punctures; terminal antennal segment in male less than 1½ times as long as the preceding two united, in the female about 1¼ times; occurring in Arizona ..... **dorannæ** n. sp.
   Callus of scutellum other than the above shape, fusiform or spear-shaped; or a single median carina 6
6. Callus of scutellum a varying fusiform or spear-shape; callus at its broadest part, covering one-third or more of the width of the scutellum . . . 7
   Callus of scutellum reduced to a single median carina, slightly widening at base 8
7. Second and third connexiva as seen from above are as wide as long; occurring in Florida ..... **cimicoides** Swed.
   Second and third connexiva as seen from above are longer than wide; occurring in Mexico, Panama, Texas ..... **notatus** Westw.
8. Slender, elongate species; abdomen barely visible from above; posterior lobe of pronotum with a single sharp point on either side smooth and punctate on scutellum; occurs in Panama ..... **angustatus** Champ.
   Shorter, broader species; abdomen roundly chordate; surface of scutellum prominently reticulate with raised lines; pronotum granulate, posterior lobe bilobed; occurs in Arizona ..... **arizonicus** Ckll.

Macrocephalus cimicoides Swederus.

Macrocephalus cimicoides auctt. (See VanDuzee, 1917).

Resembles *M. notatus* Westwood very closely. The abdomen in both sexes is wider and more heart-shaped than in *cimicoides*. The second and third segments of the connexiva in this species as seen from the dorsal aspect are as wide as long.

Nine specimens were studied, all from Florida.

Macrocephalus notatus Westwood.

Macrocephalus notatus auctt. (See VanDuzee, 1917).

Resembles *M. cimicoides* Swederus very closely. The abdomen is not as widely flaring and not as distinctly heart-shaped as in *M. cimicoides*. It may be recognized by the fact that the second and third connexiva, as seen from the dorsal aspect, are longer than wide.

Fourteen specimens were studied, from Texas, Mexico, Guatemala, and Canal Zone, Panama.

Macrocephalus manicatus (Fabricius).

Syrtis manicatus Fabricius, Syst. Rhyng., 1803, p. 123.

Handlirsch lists this as a North American species, but none were present in the collections examined by the writer. It is closely allied to *cimicoides* Swed. and *notatus* Westw., but may be distinguished from them by the fact that the scutellar callus at its widest point is less than $1/3$ as wide as the scutellum.

Macrocephalus dorannæ new species.

MALE:

Size and General Color.—Length of body, 7 to 8 mm. Width of prothorax, 2.7 to 3.2 mm. Width of abdomen, 3.2 to 3.9 mm. Color of dorsal surface mainly black or dark brown with grayish or ochraceous, small, smooth granules over the entire surface. Edges of anterior lobe of pronotum, the arrow or spear-headed callus on scutellum, and the first connexivum ochraceous buff. Second and third connexiva black or dark brown. Remainder of connexiva buff with varying amounts of dark color. Exposed part of corium dark brown or black. From the side the colors seen are light buff, mottled with brown. Coxae, trochanters and femora of all legs darker and spotted. Tibiae of fore-legs dark, and of mid and hind legs light brown. Abdomen with lateral portions just under the connexiva a reddish brown, remainder of ventral portion lighter. Antennae dark brown or black, except at the joints, which are light, and a light spot about the middle of the terminal segment.

In fresh specimens the black or dark brown may be replaced by a reddish brown wherever it is to be found, and the scutellum, antennae and legs have a greenish color. The granules do not show up as distinctly in the fresh specimens.

Head and Antennae.—Head typical of the genus, covered with very small, smooth granules. Measurements of the antennae are: second segment about one and one-fifth times as long as wide, third about one and three-fifths times as long as wide, fourth approximately twice as long as wide, and the fourth from one and one-fifth to one and three-eighths as long as two and three combined.

Thorax and Appendages.—Anterior lobe of the pronotum gently slanting to the transverse groove then widening abruptly to form the posterior lobe, which has a distinct lateral process. A small, sharp notch separates this from the posterior corner, which is slightly more rounded. Longitudinal ridges prominent from the transverse groove posteriorly to about the middle of the lobe, where they gradually diminish. Anterior lobe appears smooth beneath the granules, whereas the posterior one is slightly roughened. Sides of thorax thickly covered with small granules. Forelegs with a few larger granules on the coxa, trochanter and femur. Middle and hind legs with large and prominent granules on the coxae, trochanters, and femora, the tibiae with finer granules. Scutellum impressed at the base with a rounding area immediately posterior to this impression. Somewhat irregularly punctate in the impressed area and with very few granules. Callus very distinctive, shaped like an arrow-head, and very thickly punctate with very small punctures. Callus extends about one-half or slightly more across the scutellum, and from the base about two-thirds of the distance back. Many small granules cover the rest of the scutellum, but more occur on the callus.

Abdomen.—Chordate in shape, and thickly covered with granules on both surfaces.

FEMALE:

Length, 8.2 to 9.2 mm. Width of prothorax, 3 to 3.5 mm. Width of abdomen, 4.2 to 4.5 mm. Color in specimens observed, lighter than in male. These specimens apparently have been killed only a year or less and in color resemble the males killed in 1930, so that in fresh specimens the two sexes would be the same in coloration. Otherwise as in the male.

Holotype.— ♂, Patagonia, Arizona, September 20, 1930 (E. D. Ball). Deposited in the collection of the Agricultural Experiment Station, Tucson, Arizona.

Allotype.— ♀, same data as the holotype.

Paratypes.—7 ♂ ♂, Arizona; 1 ♂, Nogales, Arizona, October 8, 1898 (Koebele); 1 ♂, Salt River Hill, Arizona, September 26, 1924 (Hunter); 1 ♂, 4 ♀ ♀, same data as holotype and allotype; 2 ♀ ♀, Arizona; 1 ♀, Baboquivaria Mts., Arizona (F. H. Snow). Deposited in the collections of Agricultural Experi-

ment Station, Tucson, Arizona; U. S. National Museum; Cornell University, Ithaca, New York; Ohio State University, Columbus; University of Kansas, Lawrence; Stanford University, Palo Alto, California; and the author.

This species is allied to *M. cimicoides* and *M. notatus* and may be distinguished from them by the following characteristics. Callus of pronotum distinctly punctate, and spear or arrow-head shaped. Terminal antennal segment in the male less than 1½ times as long as the second and third united; in the female about 1¼ times as long as the preceding two united.

Macrocephalus arizonicus Cockerell.

Macrocephalus arizonicus Cockerell, Entomologist, XXXIII, 1900, p. 66.

This form is allied with *M. prehensilis* (Fabricius) but is larger, and has a very rough-finished appearance over the entire body due to a combination of punctures and reticulate raised lines over the pronotum and scutellum, and a noticeable granulation of the rest of the body.

Three specimens from Arizona were examined.

Macrocephalus angustatus Champion.

Macrocephalus angustatus Champion, Biologia Centrali-Americana, Rhyncota-Heteroptera, Pt. 2, 1901, p. 59.

Elongate, slender species. The abdomen is barely visible from the dorsal view. The posterior lobe of the pronotum has one distinct sharp point on each side. Smoothly finished and shallowly punctate on the pronotum and scutellum.

One specimen from Ancon, Panama.

Macrocephalus barberi new species.

MALE:

Size and General Color.—Length of body, 7 mm. Width of abdomen, 3.5 mm., scutellum approximately two times as long as wide. Ground color of the dorsal surface black or dark brown, with many tiny, smooth granules of a light color scattered over the surface, giving it a mottled appearance. Head black, fading to ochraceous on the sides, which are also mottled with darker areas. First, second, and third segments of antennae black with the exception of the joints, which are light. Fourth segment with a small dorsal spot that is dark, the rest being pale. Pronotum mainly black with the light granules grouped in some places making it appear mottled. Edges of the anterior lobe light ochraceous. Scutellum mottled and with an arrow-head shaped callus which is light at the anterior end and darker at the posterior.

Corium black with many light granules. Front connexiva entirely light colored, the remainder black with the light granules prominent, and the posterior tips of each slightly projecting and tipped with light ochraceous. Ventral surface pale ochraceous with dark spots on the thorax and coxae and femora of legs. Abdomen with a longitudinal row of small dark spots about half way up on each side.

Head and Antennae.—A slight swelling or elevation where the ocelli are located. Antennae rather short with a heavy terminal segment. Terminal segment two and one-fourth times as long as wide, third segment two times as long as wide, the terminal segment about one-fourth times as long as the preceding two taken together.

Thorax and Appendages.—Anterior lobe of pronotum widening gently to the posterior lobe which flares out abruptly and forms a transverse process, from which a slight curve leads to the rounded posterior corner. Longitudinal ridges plainly raised and converging anteriorly. Each ends in a distinct elevation or raised knob at the transverse groove. Top and sides of thorax, as well as legs, thickly covered with small, smooth granules. Fore tibiae and middle and hind tarsi without granules. Portion of corium which is exposed to view thickly set with small, smooth granules. Scutellum about 1.9 times as long as wide, quite deeply impressed near base, a prominent arrow or spear-shaped callus present for about one-half its length, and continuing posteriorly as a smooth, narrow median carina. The callus somewhat punctate, as is also the impressed area. The outer parts and the posterior third are quite thickly granulated.

Abdomen chordate and thickly covered with small granules on both surfaces.

FEMALE:

7.5 mm. long, 4.2 mm. across abdomen. Color mostly light with dark brown or black markings. The head with a small dark area around the ocelli and toward the front. Prothorax mostly light with dark spots variably scattered. Scutellum all light. Corium darker. Connexiva mottled with dark and light, the first connexivum as in male. Otherwise as the male.

Holotype.— ♂, Fern Co., California. Deposited in the U. S. National Museum.

Allotype.— ♀, Los Angeles Co., California, July. Deposited in the U. S. National Museum.

This species is medium in size, and differs from any of the specimens available for study. The roughness of the pronotum and the raised knobs or elevations on the longitudinal ridges make it distinctly different from our nearctic forms. It is probably allied to some of the Mexican or Central American species that are not included in this collection.

Macrocephalus prehensilis (Fabricius).

Syrtis prehensilis Fabricius, Syst. Rhyngotorum, 1803, p. 123.
Macrocephalus prehensilis auctt. (See VanDuzee, 1917).

This small species is closely allied to *M. uhleri* Handlirsch. It can be easily distinguished from *M. uhleri*, however, by the fact that the coarse punctures on the scutellum do not diminish in size towards the apex, and also by the absence of spine-like granules on the pronotum, sides of the thorax, and the legs, the fore-femora particularly.

Specimens studied were from the following states: North Carolina, Alabama, Kentucky, Florida, Texas, Oklahoma, Arkansas, and Kansas. Forty specimens were examined.

Macrocephalus uhleri Handlirsch.

Macrocephalus uhleri Handlirsch, Verh. Zool.-Bot. Ges. Wien, XLVIII, 1898, p. 383.

The most closely allied form to this species is *M. prehensilis* (Fabricius) from which it can be differentiated by the prominent covering of spiny granules on the anterior half of the pronotum, the sides of the thorax, and on the legs. Another aid is the fact that the punctures at the base of the scutellum diminish very noticeably in size about one-third of the way back, and are much smaller over the remaining two-thirds.

A series of eighty specimens was observed, all from Arizona.

Macrocephalus stali Handlirsch.

Macrocephalus stali Handlirsch, Ann. K. K. Nat. Hofm., Wien, XII, 1897, p. 195.

This species is closely allied to *M. prehensilis* and *uhleri*. It is easily distinguished from *uhleri* because the scutellum in *stali* is coarsely punctate throughout, whereas *uhleri* is finely punctate on the apical two-thirds. *M. stali* may be separated from *prehensilis* by the pointed, elongate granules on the anterior lobe, and the edges of that lobe, of the pronotum. The color in the male *stali* is a mottled black and yellowish on the scutellum, while in *prehensilis* it is a black stripe along the median carina of the scutellum.

Four specimens from Mexico were studied.

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EXPLANATION OF PLATES.

(All figures of prothorax drawn to same scale.)

PLATE I.

Fig. 1A. *Phymata* sp., technical terms, (Schematic).*
Fig. 1B. *Phymata* sp., lateral aspect of prothorax, technical terms.

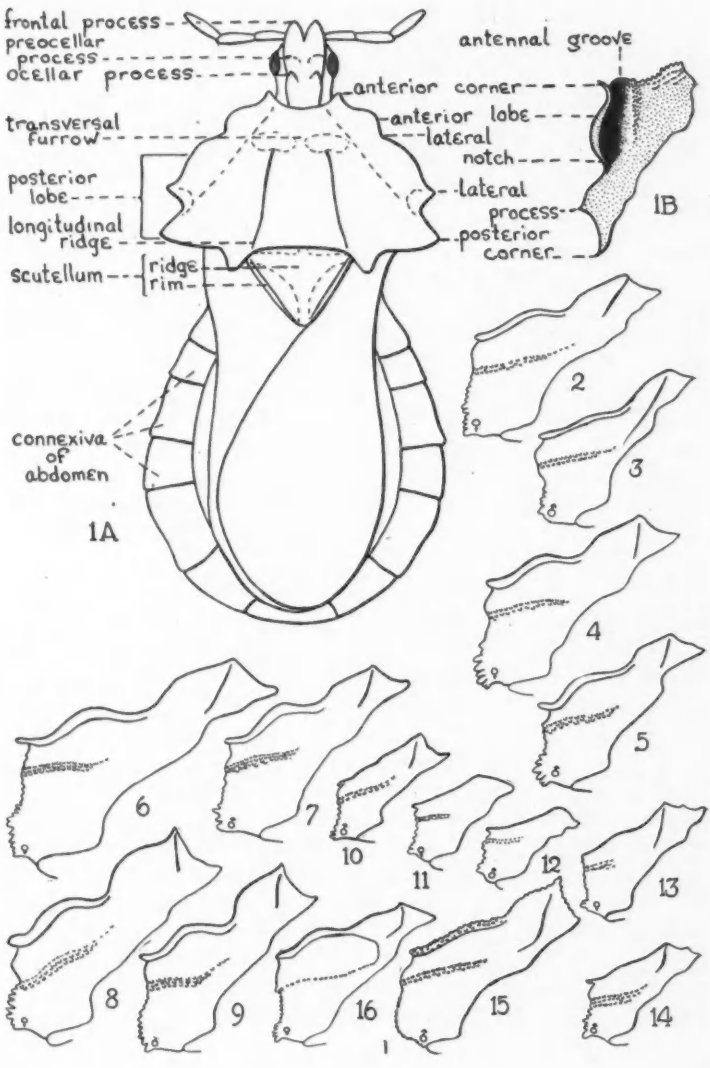
LATERAL ASPECT OF PROTHORAX.

Fig. 2. *P. pennsylvanica*, ♀.
Fig. 3. *P. pennsylvanica*, ♂.
Fig. 4. *P. pennsylvanica americana*, ♀.
Fig. 5. *P. pennsylvanica americana*, ♂.
Fig. 6. *P. pennsylvanica coloradensis*, ♀.
Fig. 7. *P. pennsylvanica coloradensis*, ♂.
Fig. 8. *P. pennsylvanica coloradensis*, ♀.
Fig. 9. P. *pennsylvanica coloradensis*, ♂.
Fig. 10. *P. albopicta*, ♂.
Fig. 11. *P. luxa*, ♀.
Fig. 12. *P. luxa*, ♂.
Fig. 13. *P. vicina*, ♀.
Fig. 14. *P. vicina*, ♂.
Fig. 15. *P. arctostaphylæ*, ♂.
Fig. 16. *P. noualhieri*, ♀.

PLATE II.

Fig. 17. *P. fasciata*, ♀.
Fig. 18. *P. fasciata*, ♂.
Fig. 19. *P. fasciata georgiensis*, ♀.
Fig. 20. *P. fasciata georgiensis*, ♂.
Fig. 21. *P. fasciata georgiensis*, ♀.
Fig. 22. *P. fasciata georgiensis*, ♂.
Fig. 23. *P. mystica*, ♀.
Fig. 24. *P. mystica*, ♂.
Fig. 25. *P. granulosa*, ♀.
Fig. 26. *P. granulosa*, ♂.
Fig. 27. *P. rossi*, ♀.
Fig. 28. *P. rossi*, ♂.
Fig. 29. *P. borica*, ♂.
Fig. 30. *P. borica*, ♀.
Fig. 31. *P. salicis*, ♀.
Fig. 32. *P. salicis*, ♂.
Fig. 33. *P. metcalfi*, ♀.
Fig. 34. *P. metcalfi*, ♂.
Fig. 35. *P. severini*, ♀.
Fig. 36. *P. severini*, ♂.
Fig. 37. *P. pacifica*, ♂.
Fig. 38. *P. pacifica*, ♀.
Fig. 39. *P. pacifica stanfordi*, ♀.
Fig. 40. *P. pacifica stanfordi*, ♂.

*Fig. 1A of Plate I modeled after Melin, 1930.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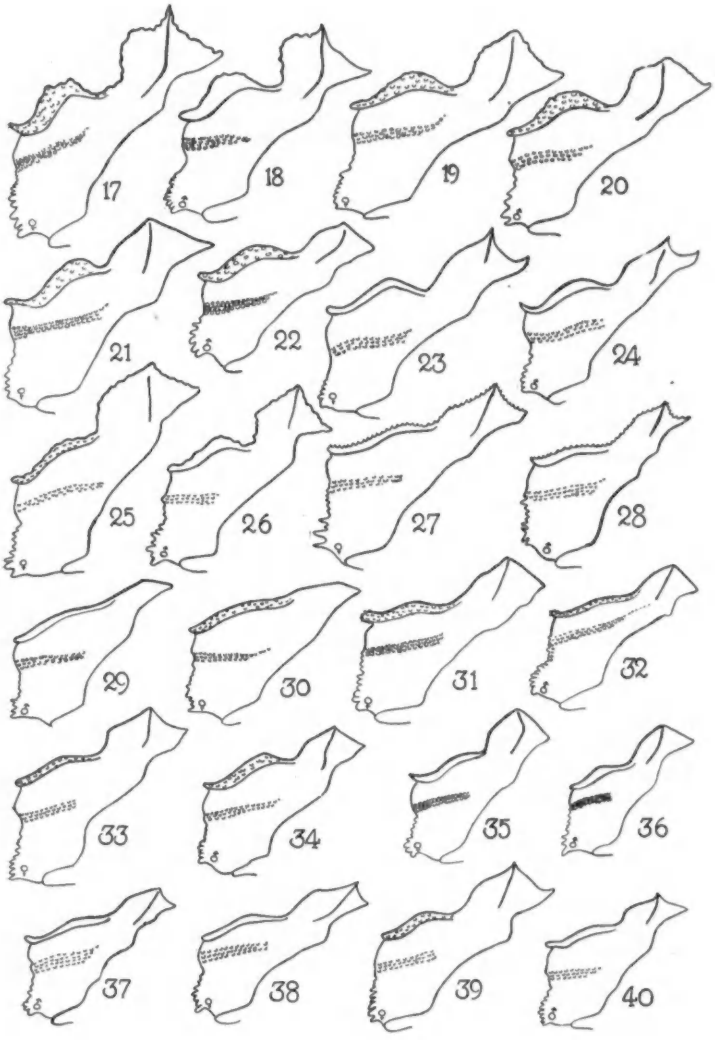
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OBSERVATIONS ON CROP AND GIZZARD MOVEMENTS IN THE COCKROACH, PERIPLANETA FULGINOSA (SERV.).

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With the exception of a few incidental observations, the literature appears to contain no detailed description of movements occurring in the insect alimentary tract observed *in situ*. Vigorous movements of the proventriculus or gizzard (honey stopper) have been observed in the bee by Cheshire (1) and by Whitcomb and Wilson (2) among others. Hobson (3) and Ten Cate (4) have made studies on the effects of various drugs and electrolytes on the isolated fore-gut of Dytiscus, but such studies are comparatively few and usually do not include observations made upon the uninjured animals. The present paper is a report of observations on the movements of the alimentary tract, especially of crop and gizzard, of the intact cockroach, *Periplaneta fulginosa* (Serv.).[1]

Method and Material.

The method of observation is quite simple, transmitted light having been frequently utilized by various investigators for other purposes, and can be readily used in connection with laboratory classes in insect physiology. It consists essentially of illuminating the body of the insect by means of a concentrated beam of light and observing the illuminated tract through a binocular dissecting microscope. The source of light is a carbon arc, or, better, a strong incandescent lamp bulb. The beam of light is passed through water to remove the heat (which with these sources of light is sufficient to kill the animal), reflected upward by a substage mirror and concentrated in the body of the insect by a substage condenser (from an ordinary compound microscope). The insect is enclosed between two glass slides, separated by walls of beeswax. The size of the chamber is adapted to the size of the insect.

[1]The author is indebted to Mr. Robert Hale Nelson for the identification of this species, a tropical form found in greenhouses at Ames.

A thin layer of vaseline between the dorsal surface of the animal and the roof of the chamber facilitates observation.

The material consists of individuals of *Periplaneta fulginosa* whose flat bodies and comparatively light pigmentation adapt them to this method of observation, which may be applied to certain other species as well. The individuals used were from a single colony, kept under approximately constant environmental conditions (i.e., of food, temperature and humidity). The food consisted of banana or a mixture of banana and animal charcoal, the latter serving to increase the opacity of the food.

Results.

Movements of the Fore-gut.

Observations of more than seventy insects in various stages of development indicate that in the apparently normal individual of this species movements of crop, gizzard and hind-gut may occur at quite different rates. The mid-gut is not easily observed by the present method. When the crop and gizzard are both vigorously active the rate of gizzard movement is usually greater than the rate of crop movement (peristalsis) while movements of the hind-gut are relatively infrequent. Variations of crop and gizzard movement are such, however, that the gizzard may appear at different times to be more or less active than the crop. The crop exhibits three types of movement: peristaltic contraction waves that move posteriorly, anti-peristaltic contraction waves that move anteriorly, and contractions involving the whole posterior third of the crop. The peristaltic waves originate, as a rule, in the esophageal or pharyngeal region; each wave appears as a constriction extending entirely around the esophagus or upper crop and then progresses posteriorly at a variable rate to disappear just anterior to the gizzard. Anti-peristaltic waves appear to consist of two kinds; waves identical in appearance to the peristaltic waves and progressing at approximately the same variable rate as the latter, and waves that seem to originate rhythmically, following upon the rhythmic contractions of the posterior third of the crop. The latter contractions themselves appear to be associated with rhythmic contractions of the gizzard, usually occurring just subsequent to contractions of the latter. The second type of anti-peristaltic wave often progresses at a more

rapid rate than the first type. Both types have been observed in the crop at the same time.

Peristaltic and anti-peristaltic waves may meet in the middle region of the crop, in which case (1) the two contractions may both disappear completely, (2) one of the waves may disappear while the other continues without modification, (3) the two waves may pass each other without obvious modification or (4) one wave may become stationary and continue its progressive movement after it has been passed by the other.

The gizzard exhibits active contractions and passive movements due to activity of the crop to which it is attached. At times the entire fore-gut is pulled vigorously in an anterior direction. Because gizzard contractions are less readily observed than those of the larger crop, an inexperienced observer finds it somewhat difficult to detect the former apart from the latter. The following observations indicate, however, that actual contraction of the latter does occur. Both the intact and excised gizzard have the same shape and general appearance; the "teeth" of the former appear as six dark spots, which converge during contraction and diverge during relaxation.[2] The contraction rate is at times decidedly different from the rate of crop movement (peristalsis). If a needle be thrust through the body wall into the contracting part, subsequent dissection shows that the needle does pierce the gizzard. Contraction of the excised gizzard, although of very infrequent occurrence, appears similar to the contraction of the organ observed *in situ*.

Contractions of the Gizzard.

When measured over short periods of time the rate of gizzard contraction appears to be fairly uniform. This is shown in Table I.

Each figure is the time required for five successive contractions to occur and is separated from the succeeding figure by a period of one or two minutes. Sometimes the rate is quite uniform as with animals 33, 19, and 29, but, usually, there appears to be a gradual but slight decrease in rate as the time of observation increases. The high initial rate is due possibly

[2] A single contraction of the gizzard consists of a definite contraction, in which the diameter of the part decreases, and of a definite relaxation, during which the diameter increases to a greater than normal value, after which the diameter returns to normal; at times the relaxation phase is more obvious than the contraction phase.

to general excitement of the animal produced by handling. There is no significant correlation between rate of contraction and body length and, presumably, none between contraction rate and stage of development. The rate is modified, however,

TABLE I.

RATES OF GIZZARD CONTRACTION.

Each figure is the time (in minutes) required for five successive contractions to occur.

No. of Insect	4	8	20	25	27	29	19	22	32	33
Length (cm.)	2.6	?	1.2	1.6	2.6	3.0	2.0	0.8	2.9	3.1
Stage of Devel.	Nymph	Nymph	Nymph	Nymph	Nymph	Adult	Nymph	Nymph	Adult	Adult
Crop	Nearly empty	Partly filled	Empty, bloated	Partly filled	Full	Empty ?	Nearly empty	Full	Empty, bloated	Partly filled
	0.470	0.250	0.545	0.400	0.200	0.215	0.600	0.270	0.260	0.235
	0.600	0.270	0.480	0.405	0.195	0.230	0.615	0.270	0.270	0.230
	0.640	0.290	0.565	0.430	0.190	0.230	0.480	0.220	0.265	0.245
	0.403	0.275	0.600	0.425	0.195	0.235	0.400	0.270	0.270	0.260
	0.340	0.300	0.615	0.460	0.190	0.250	0.440	0.260	0.295	0.245
	0.340	0.290	0.440	0.470	0.190	0.230	0.400	0.260	0.315	0.255
	0.375	0.360	0.580	0.570	0.195	0.250	0.440	0.270	0.260	0.260
	0.335	0.400	0.455	0.450	0.190	0.255	0.450	0.275	0.270	0.260
	0.350	0.205	0.560	0.475	0.200	0.260	0.425	0.285	0.325	0.275
	0.370	0.215	0.360	0.455	0.195	0.255	0.400	0.300	0.285	0.270
	0.355	0.280	0.490	0.460	0.195	0.260	0.360	0.295	0.325	0.265
	0.345	0.240	0.535	0.510	0.205	0.255	0.345	0.290	0.355	0.280
	0.325	0.455	0.385	0.500	0.190	0.255	0.295	0.340	0.290	0.280
	0.335	0.290	0.495	0.500	0.195	0.250	0.330	0.300	0.515	0.275
	0.350	0.250	0.705	0.505	0.195	0.260	0.390	0.310	0.500	0.280
	0.350	0.210	0.605	0.500	0.195	0.260	0.410	0.350	0.480	0.280
	0.350	0.255	0.510	0.515	0.220	0.305	0.400	0.355	0.470	0.280
	0.330	0.330	0.580	0.520	0.190	0.265	0.490	0.370	0.420	0.290
	0.355	0.265	0.595	0.550	0.195	0.260	0.485	0.370	0.430	0.290
	0.310	0.345	0.700	0.515	0.195	0.255	0.410	0.375	0.450	0.290
	0.300	0.310	0.845	0.500	0.195	0.260	0.435	0.368	0.440	0.320
	0.310	0.435	0.620	0.510	0.195	0.275	0.550	0.380	0.350	0.290
	0.295	0.385	0.280	0.520	0.195	0.250	0.535	0.355	0.635	0.280
	0.300	0.270	0.460	0.495	0.205	0.260	0.470	0.355	0.545	0.290
	0.310	0.270	0.485	0.550	0.195	0.275	0.440	0.355	0.670	0.350
	0.310	0.265	0.560	0.590	0.200	0.290	0.380	0.370	0.405	0.295
	0.315	0.330	0.335		0.200	0.260	0.390	0.360	0.455	0.300
	0.280	0.340	0.410		0.190	0.255	0.465	0.360	0.900	0.280
	0.300	0.220	0.525		0.195	0.270	0.410	0.360	0.250	0.285
	0.295	0.245	0.525		0.195	0.275	0.445	0.310	1.300	0.280

during and subsequent to the ingestion of food. Several direct observations indicate that during ingestion the contraction rate decreases while immediately following ingestion the contraction rate increases several fold. The acceleratory

effect of ingested food on gizzard activity is also indicated by Figure 1 which shows the distribution of contraction rates; along the abscissa are the average times of a single contraction (based on measurements of five successive contractions); along the ordinate are frequencies with which given rates have been observed. The areas with horizontal lines represent animals having full crops, the stippled areas animals with empty crops and the unruled areas animals having partially filled crops.

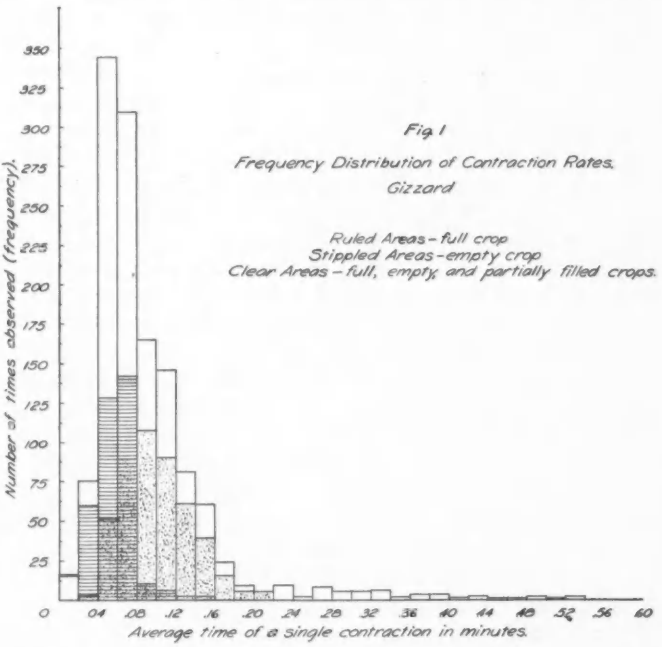

Fig. 1

Frequency Distribution of Contraction Rates. Gizzard

Ruled Areas – full crop
Stippled Areas – empty crop
Clear Areas – full, empty, and partially filled crops.

The gizzard contractions are apparently affected by other factors also; at times and for no obvious cause, the contractions cease altogether for periods up to one minute or more; movement of the whole animal (as a struggle to escape) usually involves an initial decrease followed by an increase of contraction rate; extreme dorso-ventral pressure, as would be caused by an observation chamber of much too shallow depth, tends to decrease the rate and the degree of contraction; and contraction is influenced by the animal's nervous system. The latter relationship is indicated by the following observations.

Destruction of the region of the first thoracic ganglion between the first pair of legs results in immediate cessation of the normal gizzard contractions, although crop activity continues. Destruction of the second thoracic ganglion region between the second pair of legs produces an immediate paralysis of the posterior pairs of legs but does not paralyze the first pair and does not fully stop the gizzard contractions. The latter do not cease following destruction of the region between the third pair of legs. Removal of the head by complete section at the neck as well as drawing a thread tightly about the neck results in cessation of contractions. If, however, the thread is gradually tightened until the gizzard contractions *just* cease to occur and is then loosened without further injury to the animal the gizzard can be observed to resume its activity. Destruction of neck and head regions has not resulted in uniformly consistent results. In general, however, it has been found that cautery of the supra-esophageal region of the head and neck does not completely eliminate gizzard contractions although the intensity and rate of contraction seem to be lessened; destruction of the sub-esophageal region of the head and the postero-dorsal region of the neck (beneath the anterior margin of the pronotum) seems to have a still greater eliminative effect on gizzard activity. When dissected out through the thoracic body wall, the excised crop and gizzard do not exhibit obvious contractions when not immersed in fluid or when immersed in water or a one per cent NaCl solution, even when stimulated by induced make, break or tetanizing currents of considerable strength; when, however, the head is pulled from the body, dragging the crop and gizzard with it, the crop shows much activity while the gizzard remains relatively inactive, showing at times only faint, infrequent contractions. The intact gizzard seems to be unresponsive to contact stimuli; this can be demonstrated by stimulating with a needle thrust through the body wall or down the lumen of the esophagus and crop.

Discussion.

Most of the observations described above require little discussion. It is of some interest, however, that the crop and gizzard exhibit different physiological behaviors. Although the experiments just described offer no proof, they constitute

evidence that the normal activity of the roach gizzard is immediately dependent on the integrity of the animal's nervous system, especially the central nervous system in the region of the first thoracic ganglion, while the same does not hold true for the crop. This is of some importance in view of the fact that both the crop and gizzard are usually reported to be innervated by sympathetic nerves from the stomato-gastric nervous system, and in particular by nerves from the ventricular ganglion (located on the dorsal surface of the esophagus). It is, of course, quite possible that morphologically both the gizzard and crop may receive nerves from the sympathetic nervous system while the one and not the other may be functionally dependent on the central nervous system; it is necessary that further work be done before a complete explanation of the neurological relationships of the crop and gizzard becomes available.

SUMMARY.

(1) A simple method of observing movements of the intact gut of certain insects is described.

(2) Three types of crop movement may occur: Peristaltic contraction waves, anti-peristaltic waves and contractions involving the posterior third of the crop.

(3) Contraction of the intact gizzard occurs in the normal individual of the species observed.

(4) The rate of gizzard contraction may be quite uniform over relatively short periods but may be affected by a number of different factors, some of which are mentioned.

(5) The normal activity of the gizzard appears to be dependent on the integrity of the animal's central nervous system, especially in the region of the first thoracic ganglion.

(6) The normal activity of the crop does not appear to be dependent on the integrity of the animal's central nervous system.

(7) The gizzard is relatively unresponsive to contact stimuli.

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THE RELATIVE IMPORTANCE OF AMPHIBIANS, REPTILES, BIRDS AND MAMMALS AS HOSTS FOR CHIGGERS AND OTHER ECTOPARASITES.

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INTRODUCTORY.

Ectoparasites have long received the attention of entomologists and parasitologists and their importance economically to man, likewise, has long been recognized. Yet, notwithstanding the attention they have received, resulting in the production of a voluminous literature, we are yet in ignorance of most of the fundamental facts in regard to the relative importance of the different groups of ectoparasites upon the different major classes of vertebrate hosts. Our lack of information in this regard was most forcibly brought to the writer's attention during the early days of his investigations of chiggers. When these investigations were begun about fifteen years ago, we had no knowledge regarding the natural hosts of these minute acarids and but very little in regard to their habits. Our common chigger, *Trombicula irritans* (Riley), was supposed in nature either to feed upon insects or to suck the juices of plants. Today how different! Now we know not only that they never do these things but that they occur as normal parasites on various species of vertebrates belonging to four of the five classes.

Some may ask why it was that chiggers were so long overlooked upon their natural vertebrate hosts. It would seem that any of the ectoparasites so persistently attacking man and his domestic animals would be revealed by scientists upon some of their wild vertebrate hosts. But they were not. Doubtless the chief reason for this was because of their small size. Then again, they attach themselves directly to the skin and are largely or completely concealed by the hair or feathers of the host.

Taking an Ectoparasite Census.

The demonstration of the wide occurrence of these very important parasites of man upon so many wild vertebrates was a most significant revelation of our utter lack of information in regard to the occurrence of certain ectoparasites upon the major classes of vertebrates. Hence, beginning with the summer of 1925, it was decided that a complete inventory of all arthropod parasites would be made of all amphibian and reptilian hosts that could be collected in the Central Atlantic and South Atlantic States. Three years later the same method was extended to include birds and mammals.

In taking this census of ectoparasites special methods were employed to prevent, as far as possible, their escape from their hosts before examination and also to prevent their straggling from their natural hosts to unnatural ones. Every individual parasite was taken with the exception of minute mites belonging to a few species. Each specimen was determined to species, its stage or instar recorded, and if adult its sex noted. The presence of eggs of the parasites was recorded, the nature of injury to the host and the region of the body infested, and many other items of general biological interest were put down.

Special information in regard to the host included its age (whether nestling, juvenile, breeding adult, etc.), state of health, and many other items that seemed to be of importance.

The Value of an Ectoparasite Census.

The information thus obtained will eventually give us a wealth of facts bearing upon many problems aside from the knowledge of the presence or absence of particular species upon a particular host. Some of these may be here enumerated. They have to do with:

1. The life history of the parasites themselves.
2. The seasonal history of the parasites.
3. The relative abundance of two or more parasitic species when occurring upon a single host species.
4. The time and method of spread of individuals of a parasitic species from one host individual to another.
5. The ecology of the scaly, feathered, or hairy environment furnished by the host.
6. The correlation, or lack of correlation, between the life history of the parasite and that of its host.

The data obtained up to the present are not sufficient for throwing much light upon some of these problems, but in regard to the relative abundance of the different major groups of ectoparasites on four of the classes of vertebrates it is believed that the data are of value. This of course does not apply to ectoparasites occurring outside of the territory under consideration or for the colder months of the year when no collections were made.

Host Group	Number of hosts examined	Species or subspecies represented	Without ecto-parasites	With chiggers only	With chiggers & other ectoparasites	With ectoparasites other than chiggers	Percent infested with chiggers	Percent infested with all ectoparasites
Amphibians	462	23	352	110	0	0	23.8	23.8
Reptiles	281	30	219	46	0	16	16.4	22.1
Birds	103	37	73	10	3	17	12.6	29.1
Mammals	84	13	36	2	5	41	8.3	57.1

TABLE I. Percentages of infestation with chiggers and other ectoparasites of four classes of vertebrates. (Data for spring, summer, and fall months from Atlantic States, Maryland to Florida, inclusive.)

THE RELATIVE ABUNDANCE OF THE MAJOR ECTOPARASITIC GROUPS ON VERTEBRATES DURING THE WARMER MONTHS IN THE CENTRAL ATLANTIC AND SOUTH ATLANTIC STATES.

The results obtained for this survey are given in Table I and apply to the Atlantic States, from Maryland to Florida, inclusive. Records were obtained for the spring, summer, and fall months and largely from the States of Maryland, Virginia, and North Carolina. No records were obtained from the mountainous regions in the western part of these States.

The outstanding fact revealed in this census is the important role played by amphibians as hosts for ectoparasites. Of the 462 individuals obtained, representing 23 species, no less than 110, or 23.8 per cent, were parasitized. When this census

was begun ectoparasitism of amphibians, except for occasional records of attacks by ticks, was practically unknown. It revealed, however, that amphibiams are heavily infested with mites, and are in fact more heavily infested than are reptiles.

According to this survey, mammals are the most heavily parasitized with arthropods of any of the four classes of vertebrates considered. Over 57 per cent of the mammals were found infested.

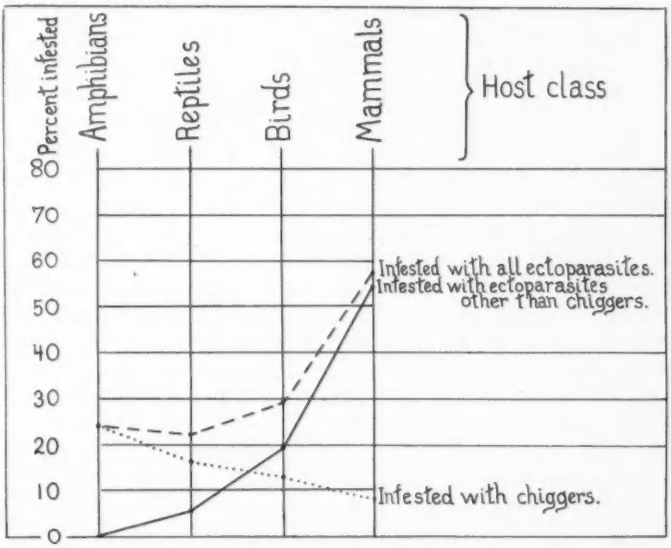

CHART I. Plot showing percentages of infestation with chiggers and other ectoparasites of hosts belonging to four classes of vertebrates.

The figures indicating the percentage of individuals infested with chiggers are of much practical importance from the standpoint of their control. Amphibians proved to be the most heavily parasitized with these mites, the percentage of individuals having them being 23.8. Reptiles came next with a percentage of 16.4, then the birds with a percentage of 12.6, while mammals were the least infested, the percentage being 8.3. In this paper no attempt shall be made to go into the details of the census taken. It might be well here to state, however, that young toads and frogs account for most of the percentage

figure for the amphibians; our common box-turtle, *Terrapene carolina*, for the reptiles; and ground-frequenting birds, for the figure for this class.

The relative abundance of chiggers and all other ectoparasites on amphibians, reptiles, birds, and mammals, as indicated by the number of individuals infested, is shown in the form of a diagram (Chart 1). This diagram indicates clearly how relatively unimportant the mammals are as hosts for chiggers, and also how this class far surpasses the other three in importance in furnishing hosts for ectoparasites other than chiggers.

Summary.

1. A preliminary report is given of what is believed to be the first census ever to be taken of the ectoparasites of four of our five classes of vertebrates, the amphibians, the reptiles, the birds, and the mammals.

2. This report is of a very general nature, and has to do primarily with the relative abundance of ectoparasites upon these four classes of vertebrates during the spring, summer, and fall months of the year in the Atlantic States from Maryland to Florida, inclusive.

3. Amphibians are shown for the first time to be hosts of major importance as far as the mites are concerned.

4. The relatively unimportant part played by mammals as hosts for chiggers in this section of the country is indicated.

BOOK NOTICE.

COMMON PESTS, by Rennie W. Doane, pp. I-VIII, 1-384 and index (13 pp.); 215 illustrations, 1931. Charles C. Thomas, publisher.

We call attention to this well written volume because it is largely entomological and because it is a well thought out effort in non-technical language to convey correct scientific information concerning pests to the lay reader. It has recently been said that scientific research is already fifty years ahead of the spread of this same knowledge among the people. This lack of understanding of science, of what it is all about, is particularly serious among legislators who now hold so many purse strings on research. Any effort of science to bridge this gap is very welcome. Professor Doane has given us a well illustrated book of this type which covers not only common insect pests but has chapters on near relatives of insects, parasitic worms, mammals and birds. The illustrations are largely from remarkably good photographs.

—C. H. K.

A METHOD OF MEASURING TRACHEAL VENTILATION IN INSECTS AND SOME RESULTS OBTAINED WITH GRASSHOPPERS.

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Iowa State College.[1]

This method of measuring the amount of tracheal ventilation produced by the respiratory movements of some insects consists of enclosing the head and thorax of an insect in one chamber and the abdomen in an adjoining chamber. The insect is sealed into the tube that connects the two chambers. The air forced from one chamber into the other through the tracheal system of the insect is then measured.

Lee[2] (1925) demonstrated that air passed into the thorax and out of the abdomen of certain Orthoptera. The method described in this paper is a quantitative method of measuring the passage of air through the tracheal system of the insect. The method is given in detail here as it is believed that it will be useful to those interested in the study of respiration in insects. The method is adapted to the study of the effect of various gases on the rate and amount of air movement into and out of the tracheal system. It may also be used to study the effect on the insect of passing various gases through the tracheal system and also to study the gain or loss of the constituents in a gas mixture after it has passed through the tracheal system.

Apparatus.

The apparatus as shown in Figure 1 consists of two closed chambers, A and B, which are connected by a tube y, into which the insect is sealed so that any air passing from one chamber to the other must pass through the tracheal system of the insect. The horizontal capillary glass tubes, A' and B', attached to each chamber are each closed by a column of water about 2 to 3 cm. long. These columns of water are free to

[1]A contribution from the Department of Zoology and Entomology, Iowa State College, Ames, Iowa.

[2]Lee, M. O. (1925) Jour. Exp. Zool., Vol. 41, pp. 125–154.

move in either direction in the tubes. Metric rulers are attached to capillaries A' and B' to facilitate the measurement of the movement of the water columns. By the use of a manometer it was determined that if the capillary tubes used are about 30 cm. long, clean and moist and the water column near the center, an increase or decrease of one ten-thousandth

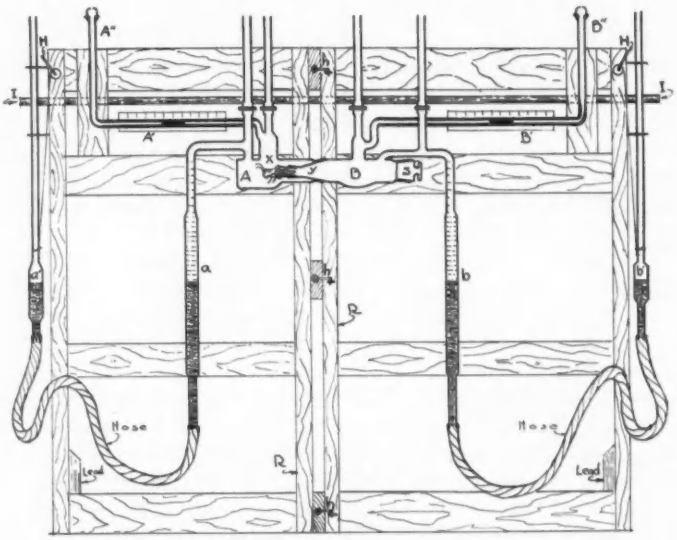

FIG. 1. An Apparatus for Measuring Tracheal Ventilation in Insects.

A.—A chamber that encloses the head and thorax of the insect. *B*.—A chamber that encloses the abdomen of the insect. *A'* and *B'*.—Capillary tubes closed by water columns. *A''* and *B''*.—Rubber bulbs. *a* and *b*.—25 cc. pipettes. *a'* and *b'*.—Adjustable reservoirs connected with pipettes *a* and *b*. *S*.—A ground glass stopper. *H*.—Handles used to adjust reservoirs *a'* and *b'*. *R*.—The two parts of the wooden rack the apparatus is mounted on. *I*.—An iron rod. *k*.—Hooks that hold the two parts of the rack together. *y*.—A tube that opens into chambers *A* and *B*. *x*.—A short piece of tube with the insect sealed inside it with beeswax and the tube, itself, sealed inside the tube *y* with vaseline.

(1–10,000) of an atmosphere in the pressure within the chamber will initiate a slow movement of the water column in the capillary. Rapid movements such as often occur during the most active respiratory movements of a grasshopper require a change in pressure of about one five-thousandth (1–5,000) of an atmosphere. With a capillary tube of between 1 and 2 mm. bore a change in the volume of the contents of either side of

the apparatus of 1 cubic millimeter can be observed. Further, it is possible with this method to maintain the air pressure in each of the two chambers in contact with the insect to within one ten-thousandth of the pressure of the surrounding atmosphere during any changes in volume of air in either or both chambers within the limit of the capacity of the moist portion of the capillary tube and the volume of the pipette, *a* or *b*, attached to the chamber. Each of these pipettes is connected by a rubber tube to a reservoir, *a'* or *b'*, containing water. These reservoirs open to the atmosphere by a long glass tube and are held in place by screw eyes driven into the side of the rack as shown in the figure. They can be raised or lowered by turning the handles, *H*. If the handle connected to pipette *a* by a cord is turned so that the reservoir *a'* is raised the water will flow from it into pipette *a* through the rubber tube connecting them. In this manner the total volume of air the *A* side of the apparatus can contain is decreased. If the reservoir is lowered the water will flow into it from pipette *a* and the volume of air that the *A* side of the apparatus can contain is increased. By repeated adjustment of the water level in pipette *a* so that the water column is kept about the center of the capillary tube *A'* a large change in volume in chamber *A* can be permitted without an increase or decrease in the pressure in the chamber of more than one-ten-thousandth of an atmosphere. The same procedure can be followed with the *B* side of the apparatus. By the selection of a suitable pipette a test of any duration can be obtained; however, it is desirable to use a pipette of a diameter as small as possible as this permits more accurate readings.

A short piece of glass tube, *x*, about 5 or 6 cm. long that will just slip inside the tube, *y*, on the part of chamber *B* that extends into chamber *A* is used in sealing the insect into the passage between the chambers. One end of this tube, *x*, is heated and shaped so that it will fit fairly snugly (within about 1 mm. on all sides) the body of the insect at the juncture of the thorax and abdomen. The tube once properly shaped may be used repeatedly for insects of the same size and shape.

Each chamber is provided with two glass stop-cocks which may be used to introduce gases or liquids into the chambers or to make the initial adjustment of the volume of air at the beginning of a test.

The rack *R* upon which the apparatus is mounted consists of 2 wooden frames held together by an iron rod *I* and three hooks *h*. The iron rod *I* is slipped through both parts of the rack allowing them to be moved separately so that after an insect is placed in tube *y* the two sides of the rack with the apparatus attached can be moved together to close chamber *A*. Chamber *A* is closed by a ground glass joint where it slips over the end of chamber *B* just back of tube *y*. Chamber *B* is closed by a ground glass stopper *S*. The rod *I* is used to suspend the apparatus in a water bath. The apparatus is held in place on the rack by heavy rubber bands. A rubber band is used to hold chambers *A* and *B* together and stopper *S* in place.

The small rubber bulbs *A″* and *B″* are used to adjust the water columns in the capillaries to the desired positions at the beginning of a test.

Procedure.

Grasshoppers, chiefly adult female *Chortophaga viridifasciata* DeG., were used as experimental specimens. It was found that if the wings were removed as close to the thorax as possible a day or two before the test a much more satisfactory seal could be made. The abdomen of such an insect was then thrust into the tube *x* until the bases of the hind legs touched the end of the tube. The end of the tube that had been shaped to fit the insect's body was in this manner brought to encircle the insect at the juncture of the thorax and abdomen. The insect was sealed to the end of the tube by applying small drops of melted beeswax (about 2 milligrams in a drop) to the edge of the tube and allowing them to come in contact with the integument of the insect as they solidified. The insect was held securely in the end of the tube during this operation. In this manner the posterior edge of the thorax and part of the anterior edge of the abdomen were sealed to the end of the glass tube *x*. The wax usually closed the tympanic spiracles. The tube with an insect sealed in the end was then filled with water and held with the insect downward to detect any leaks. If the seal was perfect, the water was removed from the tube and the insect allowed to remain quiet for, at least, 45 minutes. This permitted the initial excitement of being confined in the tube to wear off. The short piece of tube *x* was then sealed with

vaseline inside the tube *y*. Chamber *A* was closed by moving the two parts of the apparatus together until an air-tight seal was formed by the ground glass joint between chambers *A* and *B*.

The success of the test depended upon the insect being sealed perfectly into the tube that connected *A* and *B*. To test the seal the stop-cocks were closed on both the chambers and the pressure increased slightly in *A*. The pressure in either chamber may be increased by raising the level of the water in the pipette connected with it or decreased by lowering the level of water in the pipette. If an increase in the pressure in *A* produced equal movements of the water columns in both capillaries *A'* and *B'* air was leaking from *A* into *B* outside the tracheal system of the insect. If the water column in capillary *A'* moved away from the chamber, but the one in capillary *B'* remained almost stationary the seal was perfect. A further check was made by increasing and decreasing the pressure in *B* by changing the water level in pippette *b* and observing the results. Care was taken not to apply too much pressure to *A* or *B* as this would have blown the water column out of the capillary tube.

When a perfect seal was obtained the entire apparatus mounted on the rack was immersed in a water bath and allowed to remain for five minutes to assume the temperature of the bath. The water columns in the capillaries *A'* and *B'* and the level of the water in pipettes *a* and *b* were then adjusted to the desired positions with the stop-cocks on both chambers open. After closing all the stop-cocks the readings on the capillaries and pipettes were recorded and the test started. The closure of the stop-cocks enclosed a definite volume of air within the apparatus. This air could be moved from one chamber to the other by the respiratory movements of the insect but the total volume of air in the apparatus remained constant unless more or less oxygen was used by the insect than the amount of carbon dioxide given off, or changes in atmospheric pressure occurred during the test. As the grasshopper breathed the water column in capillary *A'* was observed to move toward chamber *A* and the water column in capillary *B'* was observed to move away from chamber *B*. When the water column approached the end of capillary *A'* the water level in pipette *a* was raised. This procedure forced some of the air out of pipette *a* into chamber *A* and capillary *A'* moving

the water column away from the chamber. This operation was repeated each time the insect withdrew sufficient air from chamber *A* so that the water column approached the end of capillary *A'* nearest chamber *A* As the other water column approached the end of capillary *B'* farthest from chamber *B* the water level in pipette *b* was lowered. This procedure drew air into the pipette from chamber *B* and capillary *B'* so that the water column was moved toward the end of the capillary nearest chamber *B*. As soon as the insect had forced sufficient air into chamber *B* so that the water column approached the opposite end of the capillary the operation was repeated. In this manner it was possible to observe small changes (from 1 to 400 cubic millimeters) in the volume of air in either chamber by noting the movements of the water columns in the capillaries. The total volume change (up to 25 c.c.) in either chamber could be calculated from the difference between the water levels in the pipettes and the difference between the positions of the water columns in the capillary tubes from the beginning to the end of the test.

If the apparatus had not been in operation for 30 minutes or longer before a test was started it was found advisable to moisten the walls of capillaries *A'* and *B'* by moving the water columns back and forth across the tube three or four times. The rubber bulbs *A''* and *B''* were used for this purpose. In the upper end of each bulb a small hole that could be readily closed with a finger allowed air to be either forced into or drawn out of the capillary. In this manner the water columns could be easily moved back and forth in the tube and adjusted to any desired position. During a test the holes in the bulbs permitted the maintenance of atmospheric pressure within the capillaries. By clamping the walls of the rubber bulbs firmly together with a screw clamp it was possible to prevent the water columns from being forced out of the capillaries when the apparatus was moved or tipped.

In some tests a standard solution of $Ba(OH)^2$ was placed in each chamber to absorb the CO^2 evolved by the insect. The excess $Ba(OH)^2$ that remained at the end of the test was titrated through one of the stop-cocks with a standard solution of HCl. Phenolphthalein was used as the indicator.

Chambers *A* and *B* were rinsed with distilled water at the beginning of each test. The water was allowed to stand in

the chambers for a short time to allow the air in the chambers to become nearly saturated with water vapor.

Results.

By this method it was found in all but one instance that the air was inhaled principally into the thorax and exhaled principally from the abdomen. In this one instance, *one* of 25 adult female grasshoppers, *Dissosteira carolina* Linn, exhibited very abnormal respiratory movements. The prothorax was extended and the head "nodded" rhythmically in a gasping manner. Air was inhaled principally into the abdomen and exhaled principally from the thorax. It exhibited a reversal of the usual direction of air movement through the tracheal system. Collodion was used to seal the *D. carolina* to the glass tube in the apparatus. The movement of air into the thorax and out of the abdomen in all but this one of the *D. carolina* and in all of the *C. viridifasciata* was pulsatory and periods of inactivity that lasted for as long as two minutes at 28 degrees Centigrade occurred at intervals. Frequently at the end of the rapid movement of the water column there would be a brief reversal in the direction of movement which was more noticeable on the side that enclosed the abdomen.

The results of the measurements of the total amount of air passing through the tracheal system of grasshoppers are given in Tables I and II.

As an approximate check on the rate of air passage through the tracheal system of adult female *C. viridifasciata* the movement of the water columns in the capillary tubes was timed with a stop-watch. Although the rate of movements was extremely variable it was found that 0.025 c.c. of air passed through the tracheal system in about 9 seconds, average time per gram of insect, with a minimum of 2 seconds and a maximum of 45 seconds. As the volume change and duration in each of these observations was very small the results were quite variable.

The average amount of air inhaled into the thorax at 28 degrees Centigrade at a single inhalation by adult female *C. viridifasciata* was 0.006 c.c. based on 116 observations. The maximum amount inhaled at a single inhalation was 0.015 c.c. An average of 0.006 c.c. of air was exhaled from the abdomen at a single exhalation by these insects. The maximum amount of air exhaled at a single exhalation was 0.011 c.c.

TABLE I.

Tracheal Ventilation of *Chortophaga viridifasciata* DeG. at 28° C.

Adult Females.

Test No.	Barometric Pressure in mm. of Hg.	Duration of Test in Minutes	Total Amount of Tracheal Ventilation in c. c.	Tracheal Ventilation per Minute per Gram of Insect in c. c.
1	738.6	25	2.977	0.173
2	737.7	25	3.614	0.210
3	743.1	33	4.153	0.187
4	748.9	40	4.021	0.187
5	749.2	40	3.980	0.184
6	743.0	30	3.948	0.225
7	738.0	42	5.083	0.196
8	737.2	36	5.020	0.226
9	737.2	41	5.084	0.201
10	737.7	39	2.858	0.167
11	737.7	28	2.160	0.176
12	737.7	27	1.889	0.160
13	740.2	19	2.904	0.233
14	740.2	20	3.076	0.235
15	740.2	21	3.064	0.217
16	743.5	25	4.865	0.272
17	743.6	9	1.974	0.306
18	743.6	15	3.036	0.283
19	743.6	21	2.950	0.242
20	743.6	20	3.163	0.275
21	743.6	30	4.282	0.249
22	743.6	17	3.026	0.262
23	743.5	20	3.961	0.291
24	743.5	14	3.158	0.331
25	743.4	24	4.904	0.300
26	743.4	20	2.861	0.261
27	743.3	20	2.872	0.262
28	743.2	28	4.035	0.262
29	738.8	31	4.002	0.199
30	738.7	26	3.996	0.238
31	738.7	33	5.048	0.234
32	736.0	26	3.850	0.202
33	736.0	19	3.083	0.221
34	735.5	19	2.763	0.198
35	734.4	42	3.775	0.123
36	734.0	30	3.177	0.147
37	733.9	28	2.932	0.143
38	733.3	26	2.962	0.174
39	733.1	22	3.156	0.218
40	737.3	22	3.011	0.196
41	737.3	19	3.113	0.234
	Average.....	.....	.....	.....0.222±0.043[3]

[3]Standard deviation formula = $\sqrt{\frac{\Sigma d^2}{n-1}}$

When a standard solution of $Ba(OH)_2$ was placed in each chamber during 16 tests at 23 degrees Centigrade it was found that adult female *C. viridifasciata* exhaled an average of about 20% of the CO_2 evolved from the thorax and 80% from the abdomen.

The confinement of the insects in the manner described did not seem to injure them. All the specimens studied lived a week or longer after they were released. One grasshopper which was sealed in the tube for 24 hours fed immediately after it was released. Grasshoppers that have been used as experimental animals have been observed to lay eggs which later hatched.

TABLE II.

Tracheal Ventilation of *Chortophaga virdifasciata* DeG. at 23° C.

Adult Females.

Test No.	Barometric Pressure in mm. of Hg.	Duration of Test in Minutes	Total Amount of Tracheal Ventilation in c. c.	Tracheal Ventilation per Minute per Gram of Insect in c. c.
1	747.2	63	1.554	0.055
2	747.1	65	1.468	0.050
3	733.8	61	7.168	0.166
4	733.2	79	6.330	0.113
5	742.0	67	5.942	0.146
6	742.2	67	6.085	0.147
7	745.0	30	2.023	0.107
8	745.0	50	3.041	0.095
9	744.2	35	3.008	0.135
10	743.6	44	2.010	0.086
11	743.4	65	2.612	0.074
	Average.....	.....	.....	.....0.107±0.039

SUMMARY.

A method is described that can be used to measure the tracheal ventilation of some grasshoppers.

The respiratory movements of grasshoppers, *C. viridifasciata*, produced a pulsatory streaming movement of air through the tracheal system. The air was inhaled principally into the thorax and exhaled principally from the abdomen.

Adult female *C. viridifasciata* at 28 degrees Centigrade passed an average of 0.222 c.c. of air through their tracheal system per minute per gram of body weight with a minimum of

0.123 c.c and a maximum of 0.331 c.c. At 23 degrees Centigrade similar insects passed through their tracheal system an average of 0.107 c.c. of air per minute per gram with a minimum of 0.050 c.c. and a maximum of 0.166 c.c.

Adult female *C. viridifasciata* exhale an average of 20% of the total CO_2 evolved from the thorax and 80% from the abdomen of 23 degrees Centigrade. If it can be assumed that all the exhaled air contains the same percentage of CO_2, it is evident that only part (about 80%) of the air movement within the tracheal system of these insects is a through movement in the direction given above.

ACKNOWLEDGMENTS.

The author takes this opportunity to thank Dr. C. H. Richardson under whose direction this study has been carried on for the many helpful suggestions he has made. The author also wishes to thank the other members of the Faculty of the Department of Zoology and Entomology of Iowa State College for the assistance they have given in carrying on this research.

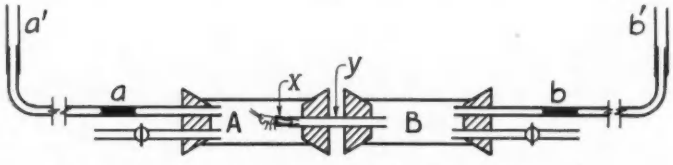

FIG. 7. A Simplified Apparatus to Demonstrate Tracheal Ventilation in Insects.

A.—A chamber to enclose the head and thorax of the insect. *B*.—A chamber to enclose the abdomen of the insect. *a* and *b*.—Capillary tubes closed by water columns. *a'* and *b'*.—Short pieces of soft rubber tube used to adjust the water columns in *a* and *b* to the desired position. *y*.—A tube connecting chambers *A* and *B*. *x*.—A short piece of tube that the insect is sealed into and that fits inside tube *y*.

APPENDIX.

At the suggestion of Dr. J. F. Yeager that a simplified apparatus of this type might be useful to demonstrate tracheal ventilation to classes in insect physiology the following apparatus was constructed.

This apparatus may be constructed from ordinary glass tubing, rubber stoppers, and thin-walled rubber tubing. Capillaries of 1–2 mm. bore have been found satisfactory for *a* and *b*.

The sizes of the tubes to form chambers *A* and *B* and tubes *x* and *y* will depend upon the size of the insect that is studied.

The operation of the apparatus is similar to that given for the apparatus shown in Figure 1. The insect is sealed into the tube *x* with beeswax. Tube *x* is sealed inside tube *y* with vaseline with the head and thorax of the grasshopper in chamber *A*. The apparatus is then assembled as shown in Figure 2. Rubber bands may be used to hold the stoppers in place. The water columns in *a* and *b* are adjusted to about the center of the moist portion of the horizontal parts of capillaries *a* and *b*. The stop-cocks are closed and the movement of the water columns in the capillaries observed.

The seal of the insect into tube *y* may be tested by increasing the pressure in chamber *A* or *B*.

The volume change that can be observed will be limited to the volume of the moist portions of the capillary tubes.

ON THE LENGTH OF THE ADULT LIFE IN THE WEBBING CLOTHES MOTH, TINEOLA BISSELLIELLA HUM.

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Although the webbing clothes moth (*Tineola bisselliella* Hum.) is a common pest in many parts of the world, few investigators seem to have been interested in the bionomics of this insect. The observations to be discussed in the present paper have been made in connection with an extensive study which is under way concerning the food habits of clothes-moth larvæ. The insects are being reared from the egg stage. As soon as the eggs hatch, each larva is placed in a small shell vial with its particular kind of food. The vials are kept in a dark cupboard under temperature and humidity conditions comparable to those of an ordinary living room. While the larvæ are small, the vials are examined from time to time as opportunity offers. When the larvæ become nearly full grown,

however, daily observations are made, as it is desired to know the exact length of the life cycle in every instance. Knowing the date of emergence, it seemed worth while to carry the observations further and to determine the length of the adult life for each individual reared.

The sexes in *Tineola bisselliella* are not easily distinguished. There appear to be no secondary sexual characters which can be relied upon. Sometimes the genitalia protrude, but often they do not. It therefore seemed advisable to cut off the end of the abdomen in each instance and to boil it, first in distilled water, and then, for another minute, in caustic potash. This procedure clears the genitalia perfectly, so that the sex of each particular specimen can be accurately determined. Of course each specimen has to be boiled separately, since each has its own special experiment number.

This paper has to do with 143 males and 171 females which have emerged in individual vials since July 12, 1930. The food in all these cases has been fur. Since the present nutrition studies were begun, a total of 531 adults have emerged, including those reared on fur. Of these 260 were males, and 271 were females. Titschack (1926:334) reared a total of 631 adults, of which 311 were males, and 320 were females. From his observations and from those already made at the Cornell Insectary, it appears that the sexes in *Tineola bisselliella* are about evenly divided.

When the length of the adult life is considered, however, there is a marked difference between the sexes. In the present study, the males have been found to live nearly twice as long as the females. For the 143 males observed, the minimum length of adult life was 13 days, the maximum 79 days, and the average 41.755 days. For the females, the minimum was 10 days, the maximum 48 days, and the average 21.818 days. Titschack's data for the females are similar to those just given, but his average for the adult life of the males is different, and is not much larger than that for the females. He found, however, that fertilized females do not live as long as do unfertilized ones. None of the adults reared so far at Cornell have been permitted to mate, so no figures are yet available for the length of the adult life of fertilized females.

For the purpose of bringing out clearly the differences between the length of the adult life of the males and that of

the females, curves have been plotted.* In order to plot these curves, it was necessary to group the insects into classes with respect to the number of days of adult life—for example, those living for 10 to 14 days, for 15 to 19 days, for 20 to 24 days, and so on—and the frequency values had to be changed into percentages. Based on this arrangement of data, the mean in the males was found to be 41.790 days, with a probable error of ± .676, while the mean in the females was found to

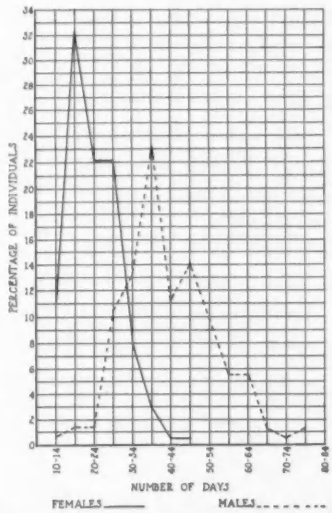

CHART I. Length of adult life in the webbing clothes moth (*Tineola bisselliella* Hum.): a comparison of the length of adult life in the male with that in the female. The curves are based on data obtained from the adult life of 143 males and 171 females.

be 21.912 days, with a probable error of ± .348. The difference between the two means is 19.878, while the probable error of that difference is ± .760. When the difference between two means is four or more times the probable error of that difference, the difference is considered statistically significant. With the data represented by the curves, the difference between the two

*The author wishes to acknowledge her indebtedness to Professors H. H. Love and J. R. Livermore, of the Department of Plant Breeding at Cornell University, for advice and assistance in connection with the statistical phases of the problem.

means is over twenty-six times the probable error of that difference. The data at hand, therefore, seem to have conclusively proved that the length of the adult life of the males is much longer than is that of the females.

The adult of *Tineola bisselliella* is commonly said to have poorly developed or degenerate mouth parts. Titschack (1922:15) gives a figure in which he shows that the proboscis is lacking, although the labial palpi are prominent, as in most Lepidoptera. But even if the adult possessed a well developed proboscis, what liquid food could it find in a small vial containing nothing but a piece of dry fur? It therefore appears that the webbing clothes moth must consume enough food during its larval stage to carry it through, not only the pupal stage, but through an adult life which averages nearly six weeks for the males and about three weeks for the females.

As more data become available, it will be interesting to determine whether there is any correlation between the kind of food on which the larva has been reared and the length of the adult life.

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BOOK NOTICE.

ANIMAL ECOLOGY WITH ESPECIAL REFERENCE TO INSECTS, by ROYAL N. CHAPMAN, pp. I-X, —464, including an appendix of 40 pages by Volterra; 137 graphs and other illustrations. McGraw-Hill Book Company. Inc., New York and London.

As all economic entomology is basically applied ecology, this is a volume that should be in the hands of every economic entomologist. As it is the latest presentation of the principles of the science it will be the class and textbook for students. It has special significance in its field of thought because in it are fully outlined for the first time Chapman's own contributions, the principles of biotic potential and environmental resistance. As the volume deals with principles it is largely on the field of autecology. Our great lack of a knowledge of synecology is shown by the 113 pages given to aquatic ecology as against 45 pages devoted to the ecology of land forms, yet the great variety of life is on land, certainly much over 75 per cent of all living forms and with insects an even higher percentage, as insects rarely invade the sea. Land ecology (terrestrial synecology) is almost an unexplored field. Work on land forms will long remain largely in the field of qualitative ecology as against the more ideal quantative ecology as presented in this admirable volume. The book is a landmark in entomology, American or otherwise, and substantiates the outstanding position of Professor Chapman in entomology.

—C. H. K.

NEW WEST INDIAN DIPLOPTERA.

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The following descriptions of new species and varieties of West Indian Vespidae have been in manuscript for some time. It was our intention to include them in a revision of the Diploptera of the Antilles, which, however, may not be published in the near future. Since types and paratypes of these new forms have been distributed in various collections,[3] it seems advisable to publish the descriptions without further delay. The affinities of these forms will be discussed in the final paper, where we also hope to figure the structural characters of the several species.

Zethus bahamensis, new species.

Medium-sized, moderately slender. Black, with the legs, antennae, and base of first and second abdominal segments partly red, and with very few yellow markings.

Length (h. + th. + t. 1 + 2): ♀, 13 mm.

Female.—Head, seen from above, more transverse than in *Z. poeyi* H. de Saussure, being over twice as wide as long and considerably broader than the thorax, the posterior margin much more deeply emarginate than in *Z. poeyi*. Vertex and cheeks margined throughout by a carina, which is rather low and blunt on the vertex and the lower

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[3]Note. The following abbreviations have been used throughout for the location of the types:
A. M. N. H.—American Museum of Natural History.
A. N. S. Phila.—Academy of Natural Sciences of Philadelphia.
B. M.—British Museum.
C. M.—Carnegie Museum, Pittsburgh.
Corn. Univ.—Dept. of Entomology of Cornell University.
Est. Agr. C.—Estacion Exp. Agronomica de Cuba.
M. C. Z.—Museum of Comparative Zoology, Cambridge, Mass.
N. Y. Ac. Sci.—New York Academy of Sciences Survey (deposited at the American Museum of Natural History).
U. S. N. M.—United States National Museum.

half of the cheeks, but becomes very high and sharp on the upper half of the cheeks where it forms (as seen from above) a sharp angle; about the middle of the cheeks, where the carina becomes lower, it sends off a branch on the under side of the head separating the postgenae from the occiput, the point of junction (seen in profile) being not in the least projecting. Cheeks well developed, somewhat more swollen behind the eyes than in *Z. poeyi;* in profile a little narrower than the widest part of the eye. Oculo-malar space absent. Inner orbits a little farther apart on the vertex than at the clypeus. Ocelli placed as in *Z. poeyi*, but relatively nearer the occipital margin. Interocellar area only slightly depressed in the middle, not appreciably ridged on the sides near the posterior ocelli. Antennae twice as far apart as from the inner orbits; the space between them much more raised than in *Z. poeyi*, the upper part forming a transverse ridge much flattened and smooth in the middle where it connects with a low, blunt, interantennal carina; no longitudinal depression below the anterior ocellus, but the raised frons (above the insertion of the antennae) with a median fovea. Clypeus much as in *Z. poeyi*, but the apical truncation slightly narrower, with very blunt edges, and the slight median projection not tuberculate. Eyes bare. Antennae and mandibles as in *Z. poeyi*. Thorax, seen from above, broadly elliptical, distinctly more stubby than in *Z. poeyi*, one and one-half times as long as wide, broadly truncate posteriorly and anteriorly; in profile one and one-third times as long as high. Pronotum short, much wider and more convex on the sides (as seen from above) than in *Z. poeyi;* anterior margin very slightly concave, with a strong, opaque, raised lamella which is only slightly higher in the middle and continues downward to within a short distance of the front coxae; humeral angles rounded, but more prominent than in *Z. poeyi;* a lateral carina in front of the posterior lobe, as in that species. Mesonotum with three longitudinal impressed lines, as in *Z. poeyi*, but the traces of notauli less distinct than in that species owing to the coarser sculpture. Scutellum much more raised than in *Z. poeyi* and with a deep, narrow, median, longitudinal groove, separated from the mesonotum by a very narrow groove which is not foveolate. Postscutellum transverse, without carinae, ridges, longitudinal grooves or teeth, uniformly convex, but more swollen than in *Z. poeyi*. Mesopleura as in *Z. poeyi*. Propodeum very short; with an almost vertical concavity, which is very shallow, bears a median impressed line but no carina, and is not striate; superior and inferior ridges broadly rounded; lateral ridges with a sharp but low carina; lateral angles broadly rounded. First abdominal segment about as long as the thorax, but shorter than the second segment; shaped almost exactly as in *Z. poeyi*, although a little broader toward the apex; greatest width at about the middle of the length and about one and one-half times the width at the apex; basal stalk much as in *Z. poeyi*, with a sharp transverse carina behind the extensory muscle, but without the longitudinal ridges of that species; preapical, transverse depression hardly marked and forming no basin in the middle. Second segment bell-shaped, in outline intermediate between that of *Z. poeyi* and that of *Z. cubensis* Zavattari, being rather

gradually narrowed into a slender neck which is about one and one-half times as long as the width of the basal articulation; swollen portion, seen from above, about as wide as long, and, in profile, slightly longer than high, moderately and equally swollen above and below; apical margin duplicate, the terminal lamella flat, not expanded on the sides, and not translucent. Apical margins of succeeding segments simple, not duplicate. Legs as in *Z. poeyi;* middle tibiae with a single, long, apical spur; middle and hind tibiae with the usual apical comb of heavy spines. Wing venation much as in *Z. poeyi;* third cubital cell much shorter than the second on the cubitus and distinctly higher than wide.

Puncturation very coarse and dense on head and thorax; vertex, frons, pronotum, mesonotum and mesopleura almost rugoso-reticulate; the rugosities having a tendency to form longitudinal striae on the frons; the punctures smaller and more scattered in the upper third and in the center of the clypeus. Propodeum almost impunctate, except for a few, very scattered, medium-sized punctures on the dorsal areas, which in addition bear in their posterior half a few irregular, transverse striae. Anterior part of mesopleura (in front of the epicnemial carina), their extreme posterior edge, and metapleura impunctate; upper half of metapleura with about eight transverse striae which are much more pronounced than in *Z. poeyi.* Tegulae with a few scattered, medium-sized punctures. First abdominal tergite with scattered, medium-sized punctures which are distinctly larger and more numerous than in *Z. poeyi;* second tergite practically impunctate, the few punctures being visible only under a high magnification. On the second sternite the punctures are numerous, rather scattered, and medium-sized, being about as large as those of the first tergite. Succeeding segments sparsely covered with rather small punctures. Abdomen more shiny than head and thorax, which are uniformly dull. Pubescence very short and sparse, grayish, somewhat longer and more abundant on the sides of the clypeus, in the antennal pits, on the sides of the thorax, on the propodeum, on the legs, and on the under side and at the base of the first abdominal segment.

Black. Under side of the first three and the last antennal segments, legs (except most of the coxae), tegulae, and stalk-like bases of the first and second abdominal segments, reddish brown (Ridgway's burnt sienna); hind margin of pronotum very narrowly reddish in its posterior half. The only sulphur-yellow markings (Ridgway's light cadmium) in the type and paratype are a small, transverse spot on each side of the frons above the insertions of the antennae, a moderately wide and somewhat wavy, pre-apical fascia on the first tergite (much produced anteriorly and broadly rounded on the sides), and traces of a narrow pre-apical fascia on the sides of the second tergite. Wings infuscate, purplish brown, somewhat ferruginous toward the base; stigma and veins black; costa and veins near the base ferruginous.

BAHAMAS. Nassau, New Providence, two females (G. P. Engelhardt); holotype in M. C. Z.

Eumenes (Delta) confusus, new species.

Eumenes abdominalis H. de Saussure, 1852, 'Et. Fam. Vesp.,' I, p. 70 (♀). H. Lucas, 1856, in de la Sagra, 'Historia Fis. Pol. Nat. Cuba,' Segunda Parte, Hist. Nat., VII, p. 321 (♀); 1857, in de la Sagra, 'Histoire Phys. Pol. Nat. Cuba,' VII, p. 768 (♀). F. Smith, 1857, 'Cat. Hym. Brit. Mus.,' V, p. 32. Cresson, 1865, Proc. Ent. Soc. Philadelphia, IV, p. 157 (♀ ♂). Stahl, 1882, Fauna de Puerto-Rico, p. 201. Gundlach, 1886, 'Contrib. Ent. Cubana,' II, p. 145. Not *Sphex abdominalis* Drury, 1773.

Eumenes (Zeta) abdominalis H. de Saussure, 1875, Smithson. Miscell. Coll., XIV, No. 254, p. 106 (♀ ♂). Zavattari, 1912, Arch. f. Naturgesch., LXXVIII, Abt. A, Heft 4, p. 125 (♀).

Eumenes colona H. Lucas, 1856, in de la Sagra, 'Historia Fis. Pol. Nat. Cuba,' Segunda Parte, Hist. Nat., VII, p. 321 (♀); 1857, in de la Sagra, 'Histoire Phys. Pol. Nat. Cuba,' VII, p. 767 (♀); Atlas, Pl. XIX, fig. 1 (♀). Ashmead, 1900, Trans. Ent. Soc. London, p. 312 (in part). Not *E. colona* H. de Saussure, 1852.

The common, large Cuban species of *Eumenes* appears to be without a valid name. Following de Saussure's example, it has thus far been generally called "*E. abdominalis,*" in the belief that it was identical with *Sphex abdominalis* Drury. But Drury's species was from Jamaica and, moreover, his description (especially of the color of the first abdominal segment) does not fit the Cuban wasp. *Eumenes colona* H. de Saussure, likewise, was based upon a wasp from Jamaica which we regard as identical with *Sphex abdominalis* Drury, so that the name *colona* also is not available for the Cuban species.

The typical color form of *E. confusus,* of Cuba, may be described as follows:

A large species. Mostly red, with a few black and numerous sulphur yellow markings on head, thorax and first abdominal segment.

Length (h. + th. + t. 1 + 2) : ♀, 17 to 18 mm.; ♂, 16 to 16.5 mm.

Female.—Head, seen in front, about one and one-third times as wide as high; seen from above, transverse, about two and one-half times as wide as long, about as wide as the thorax. Vertex and cheeks margined throughout by a sharp carina, which on the vertex is moderately below the level of the ocelli. Cheeks very narrow, in profile not much wider in their upper half than below. Oculo-malar space absent. Inner orbits but little farther apart on the vertex than at the clypeus. Ocelli in a flattened triangle; the posterior pair a little farther apart than from the eyes; the anterior ocellus only a little larger than the posterior ocelli. Interocellar area flat; vertex without fovea. Antennae twice as far apart as from the inner orbits; frons between them raised longitudinally; the ridge meeting an obtuse, transverse crest above the middle of the interantennal area, the point of junction forming a truncate tubercle; above the tubercle a fine carina runs to about midway from

the anterior ocellus. Clypeus about one and one-quarter times as long as wide, almost regularly octagonal, moderately and uniformly convex over the entire surface; the anterior, free portion about three-quarters the length of the upper, interocular part; the apical margin more than one-third of the total width of the clypeus, shallowly, arcuately emarginate, with very broadly rounded edges. Eyes bare. Antenna elongate; flagellum rather distinctly but moderately swollen in its terminal half; scape less than one-third the length of the flagellum; third antennal segment about twice as long as the fourth; fourth to sixth distinctly longer than wide; seventh almost square; eighth to eleventh distinctly wider than long; twelfth about as long as wide at the base. Mandibles elongate, straight, of the usual *Eumenes*-shape; the apex very blunt and slightly curved; inner margin with three superficial notches, the salient portions forming three wide teeth, of which the middle one bears a blunt median projection. Thorax short ovate; seen from above, a little longer than wide, more distinctly longer than high in profile. Pronotum squarely truncate anteriorly, with a fine, continuous rim which extends on the sides to near the front coxae where it is more carinate; the rim avoiding the humeral angles and running in front of them and along the vertical face of the pronotum. Humeral angles very prominent, flattened into sharp crests, as seen from above forming bluntly rounded right angles. Mesonotum slightly longer than wide, its anterior half with a median impressed line bordered by very fine carinae, its posterior half with an impressed line on each side above the tegulae and with shallow traces of notauli close to the scutellum. Scutellum uniformly and moderately convex, with a fine, slightly raised median line in its anterior half; postscutellum moderately convex and wholly within the posterior slope of the thorax. Propodeum, seen from above, short, moderately convex; completely rounded off at the sides, without ridges or projecting angles; its concavity broad and deep, but separated from the postscutellum by a narrow, convex area; the bottom of the concavity with a deep furrow divided into foveolae by short transverse ribs and continued upward to near the postscutellum. First abdominal segment very long and slender; more or less ribbon-shaped; about as long as the thorax and about three to four times as long as its greatest width (the proportions varying rather considerably in our specimens); in profile very slightly but uniformly curved throughout its length; the ventral curve is divided into two shallow bows by a slight blunt tubercle placed on each side of the middle line, on the ventral side of the segment, below and a little before the spiracle; basal third stalk-like, gradually thickened behind, the apical two-thirds not more than twice as thick as the base; seen from above, widening rather rapidly, the apical two-thirds being almost parallel-sided and two and one-half to three times as wide as the basal stalk; its apex with slightly projecting, blunt angles; spiracles slightly protuberant, not visible from above; the apical, wider portion much flattened dorsally, even somewhat depressed before the middle, with a deep, median, longitudinal groove. Second segment depressed, bell-shaped, moderately and evenly swollen dorsally and ventrally, much longer than high or wide; the basal

neck very short; the sternite slightly convex at the base; apex of sternite and tergite simple, flat. Legs normal, slender.

Punctucation dense and coarsely granular on most of head and thorax; finer and very scattered on clypeus, cheeks, lower part of face (below the antennae), and postocellar portion of vertex. Tegulae, anterior portion of mesopleura, metapleura and ventral areas of propodeum almost impunctate. Abdomen practically impunctate; the first tergite without or with very few, microscopic punctures. Pubescence short but rather dense and mostly rufous on head and thorax; very sparse on the abdomen.

Mostly red; the thorax duller, more ferruginous red (Ridgway's burnt sienna), the abdomen brighter, almost orange red (Ridgway's mars orange). The black parts are: last six segments of flagellum above; a transverse fascia on the frons, above the insertion of the antennae; a fascia on the vertex, including the ocellar triangle and extending to the margin of the eyes; posterior face of head; broad posterior and narrow anterior margins of mesonotum, as well as a narrow median line on its anterior half; narrow anterior margins of scutellum and postscutellum; sternum; extreme anterior portion of mesopleura; mesepimera; metapleura; a narrow, median longitudinal line on propodeum; extreme base of first abdominal segment; posterior face of front and middle coxae and most of hind coxae. The extent of the black markings varies slightly. The yellow markings (Ridgway's cadmium yellow) are far more extensive and distributed as follows: clypeus; frons below the ocelli, except the black supra-antennal fascia, but including the sinuses of the eyes; a line along each outer orbit, the two lines connecting across the vertex behind the ocelli; mandibles, except their margins and tip; sometimes the under side of the antennal scape; pronotum (with small, indefinite ferruginous blotches dorsally); most of scutellum and postscutellum; most of propodeum (three connected ferruginous spots in the upper dorsal half, and ferruginous blotches on the sides); most of mesepisterna; tegulae (more or less ferruginous in the center); an apical fascia on the first abdominal segment, very narrow on the tergite, broader and produced anteriorly in the middle on the sternite; a narrow pre-apical fascia on the second segment, generally irregular and often suffused with ferruginous so as almost to disappear; under side of femora more or less extensively, and most of front and middle tibiae, as well as blotches on the tarsi (the yellow and ferruginous of the legs more or less intergrading). Wings very slightly infuscate; distinctly amber yellow in their basal half, a little darker and slightly purplish in their apical half; stigma amber yellow; veins brown, more ferruginous in the basal half.

Male.—Similar to the female, except for the following differences. Eyes much closer together at the clypeus than on the vertex; posterior ocelli almost twice as far apart as from the eyes. Clypeus one and one-half times as long as wide, almost elongate hexagonal; the anterior, free portion about two-thirds the length of the upper, interocular part; the apical margin as in the female. Antenna much elongate, most of the segments of the flagellum longer than wide; thirteenth segment very large, folded beneath so that its apex reaches the base of the eleventh

segment, in profile shaped like a duck's head; its dorsal face with a prominent, wide hump which is abruptly truncate distally, so as to form a sharp edge; the face of the truncation with a short, oblique ridge in its upper part; the apical portion of the segment finger-shaped, not carinate, with blunt point, and about as long as the upper edge of the basal, swollen portion. Last abdominal sternite uniformly flattened throughout. The genitalia are of the usual *Eumenes*-type; the shaft of the penis is slender throughout, slightly expanded and bluntly rounded at the apex.

Flagellum more extensively black than in the female. Apical sternite of abdomen black.

CUBA. Santiago de Cuba (A. M. N. H.; U. S. N. M.). Havana (C. F. Baker.—Corn. Univ.). Guanabo, Havana (Bromley). Santiago de las Vegas, common (Est. Agr. C.). Hoyo Colorado (C. Enamorado). Cienaga, Prov. Havana (M. C. Z.). La Mina, near Cienfuegos; Soledad, several specimens, including the holotype (♀) and allotype (♂) at M. C. Z. (George Salt). Preston, Oriente (J. Bequaert). One male and one female, labelled "Cuba" (A. N. S. Phila.). Specimens here listed (except holotype and allotype) are paratypes.

Eumenes confusus var. **pinetorum,** new variety.

Eumenes ferruginea Holland, 1917, Ann. Carnegie Mus., XI, p. 293. Not of Cresson, 1865.

A pair (holotype ♀ and allotype ♂) from Nueva Gerona, ISLE OF PINES (G. Link), at the Carnegie Museum, Pittsburgh, agree structurally with the Cuban *E. confusus*, but represent a distinct color form, in which the yellow markings are much reduced. Another pair (paratypes), from the same source, are at the United States National Museum. A third pair (paratypes), bred from a nest also found at Nueva Gerona by S. C. Bruner and Y. L. Bouclé, September 4–12, 1928, is at the M. C. Z.

Length (h. + th. + t. 1 + 2) : ♀, 15.5 to 17.5 mm.; ♂, 15 to 16.5 mm.

Female.—The body is uniformly ferruginous red (Ridgway's mahogany red). The few black markings are about as in the typical form, as are also the yellow markings of the head, abdomen and legs. On the thorax, however, the yellow color (Ridgway's light cadmium) is confined to the postscutellum, ill-defined blotches on the posterior portion of the mesepisterna, the inner corners of the tegulae, and faint traces along the lateral and inferior ridges of the propodeum (more distinct at the apex). The color of the wings shows no difference.

Male.—Colored much like the female.

Eumenes abdominalis (Drury) var. **hispaniolae,** new variety.

Eumenes abdominalis var. *colona* H. de Saussure, 1875, Smithson. Miscell. Coll., XIV, No. 254, p. 107 (in part). Dalla Torre, 1894, 'Cat. Hym.,' IX, p. 16 (in part).

Eumenes colona Ashmead, 1900, Trans. Ent. Soc. London, p. 312 (in part).

Eumenes abdominalis colona W. A. Schulz, 1903, Sitzungsber. Math. Phys. Kl. Akad. Wiss. München, XXXIII, Heft 3, p. 483 (♀).

Eumenes (*Zeta*) *colonus* Zavattari, 1912, Arch. f. Naturgesch., LXXVIII, Abt. A, Heft 4, p. 126 (♀ ♂).

Female.—Head black; clypeus, a broad spot between the antennae, inner orbits from the clypeus to the upper margin of the sinus of the eyes, a transverse stripe between frons and vertex, and outer orbits, sulphur yellow; mandibles ferruginous with a yellow stripe; antennae ferruginous in their basal half, the apical half black above, ferruginous beneath. Thorax mostly sulphur yellow (Ridgway's light cadmium); the narrow sutures, a broad longitudinal stripe over the anterior two-thirds of the mesonotum (much widened anteriorly and rounded posteriorly), the posterior margin of the mesonotum, the anterior margin of the scutellum, sometimes a small spot on the sides of the pronotum (above the coxae), the sternum, the anterior and posterior portion of the mesopleura, the metapleura, and the outer margins and middle line of the propodeum, black; tegulae ferruginous. First abdominal segment black, suffused with ferruginous before the apex, and with a broad, apical yellow fascia dorsally and ventrally; extreme base of the second segment black; remainder of abdomen ferruginous to chestnut (Ridgway's burnt sienna to chestnut), rather diffusely marked with yellow ventrally. Second tergite with a narrow, apical, yellow fascia, somewhat widened in the middle line. Legs ferruginous red; coxae and trochanters black; tibiae indistinctly spotted with yellow. Wings very slightly infuscate, distinctly amber yellow in their basal half, a little darker and somewhat purplish in their apical half; stigma amber yellow; veins brown, more ferruginous in the basal half.

Male.—Extremely similar to the female. The only differences we can discover are that the yellow interantennal mark is fused with the yellow inner orbits above the clypeus, and that the transverse stripe below the ocelli is reduced and broadly interrupted in the middle.

SANTO DOMINGO. Port-au-Prince, Haiti, one female, holotype (M. C. Z.), and one female, paratype (G. N. Wolcott.—U. S. N. M.). Haiti, without more definite locality, one male, allotype (U. S. N. M.).

Ancistrocerus (Ancistrocerus) domingensis, new species.

A medium-sized, rather stubby species. Black, with a few ivory-white markings on head and thorax and ivory-white apical fasciae on first, second and third abdominal tergites and on second sternite.

Length (h. + th. + t. 1 + 2) : ♂, 7 mm.

Male.—Head, seen in front, subcircular, very slightly wider than high; seen from above, transverse, less than twice as wide as long, slightly wider than the thorax; occipital margin distinctly, but very evenly concave. Vertex and cheeks margined throughout by a sharp carina which is slightly higher along the cheeks than on the vertex. Cheeks moderately wide, distinctly swollen in their upper half (the swollen portion almost forming a blunt ridge behind the outer upper orbits), about half as wide as the upper part of the eye in profile, rather abruptly narrowed in their lower third where the carina is broadly rounded and forms a very slight angle. Inner orbits a little more than twice as far apart on the vertex than at the clypeus. Upper half of frons hardly swollen. Eyes unusually large and rather bulging. Ocelli in a slightly flattened triangle; the posterior pair nearly twice as far apart as from the eyes and even farther from the occipital margin than from each other. Interocellar area flat; vertex without fovea. Antennae much farther apart than from the inner orbits and rather far from the upper margin of the clypeus; the ridge between them hardly developed, except in the upper part where it is very low and blunt. Clypeus irregularly pentagonal, about as long as its greatest width which is at the lower third, hardly convex and slightly grooved in the middle of its lower half; the anterior, free portion less than half the length of the upper, interocular part; the slight, regularly arcuate emargination of the apex nearly one-third of the greatest width of the clypeus, with sharp but short lateral angles. Antenna moderately elongate; flagellum conspicuously swollen in its apical third, with most of the segments bead-like; scape short, slightly curved, less than one-fourth the length of the flagellum; third antennal segment one and one-half times the length of the fourth; fourth to seventh decreasingly longer than wide; eighth to tenth wider than long; eleventh one and one-third times as long as wide at base, excavated beneath; twelfth larger than usual, nearly as long as the next; thirteenth (hook) moderately long, distinctly flattened, in profile from above triangular, with sharp, slightly curved tip which reaches the apex of the tenth segment, from below broadly triangular with very bluntly rounded apex. Mandible only half the length of the eye, tapering rapidly from a broad base to a very sharp, moderately curved apex; inner margin with very superficial notches; outer surface with two fine, longitudinal, converging ridges, which meet far before the apex. Thorax elongate rectangular, one and one-third times as long as wide and slightly wider than high, slightly narrowed anteriorly and posteriorly, a little more so anteriorly. Pronotum not narrowed behind the humeral angles; anterior margin almost straight dorsally (very slightly curved inwardly), with a strongly raised, translucent lamella stopping abruptly at the humeral angles, below which a blunt carina runs to near the front coxa; humeral angles, seen from above, very slightly projecting, bluntly rounded, not tuberculate. Mesonotum slightly longer than wide, elongate pentagonal with the anterior half produced, distinctly convex; notauli indicated in the posterior fourth only. Tegula longer than wide, with broadly rounded outer margin, of normal shape; post-tegula small, finger-shaped and curved. Scutellum rectangular; its

median portion (between the deep lateral grooves) about twice as wide as long, flat, faintly depressed in the middle close to the hind margin; without tubercles or carinae; suture dividing it from the mesonotum coarsely foveolate. Postscutellum without tubercles or median depressions; its median portion irregularly pentagonal with rounded angles, about as long as the scutellum and nearly twice as wide at the anterior margin as long in the middle, separated on each side by a fine carina from the lateral, somewhat pitted depressions; a deep pit in the anterior corner, within the carina; its surface flat anteriorly, slightly sloping in the posterior third, the edge between the two areas somewhat raised. Mesepisternal suture continuous; no trace of epicnemial carina. Propodeum long, vertically truncate and deeply concave behind, not swollen on the sides; dorsal areas touching each other in the middle over a long distance (about one-third of the length of the postscutellum), the postscutellum broadly separated from the concavity by a slightly sloping area; superior ridge slightly raised into a very fine carina; lateral ridge and upper half of inferior ridge bluntly rounded; lower half of inferior ridge forming a somewhat translucent lamella which is united with the valvula; concavity wide, moderately deep, divided throughout by a longitudinal furrow; lateral angles broadly rounded, not produced. Abdomen rather stubby. First tergite short, transverse, very little narrower than the second, in outline cup-shaped with strongly angular sides, about one and one-third times as wide as long; its horizontal face, in profile, about half the length of the second tergite; its anterior vertical face sloping rather abruptly and forming a distinct angle with the posterior, horizontal portion; the two areas separated by a high, straight, regular carina; the carina limited behind by a depression and, seen from above, projecting on each side as a broadly rounded angle; its lateral extensions joining the slightly thickened apical margin of the tergite; its horizontal portion convex, with a slight median depression before the apex, not longer in the middle than at the sides, widest at the apical margin where its width is about one and two-thirds times its length in the middle. Second segment about as long as wide at apex, much more convex dorsally than ventrally; its apical margin simple, straight, not thickened, very narrowly translucent at the extreme edge; its dorsal surface normal, very faintly flattened in the middle before the apical margin; its base apparently not forming a mite chamber, the transverse furrow behind the articulation smooth, not foveolate; its sternite very gradually sloping and gently rounded toward the base, without median depression and without riblets or foveolae in the furrow behind the articulation. Legs rather stout and short; femora somewhat swollen, of normal shape; claws almost entire, with a very slight notch on the inner side before the apex. Wings with the usual type of venation; radial cell strongly and rather rapidly widened opposite the second cubital, truncate at apex with a distinct appendicular vein; third cubital much longer than high; stigma much wider than usual. Genitalia of the usual shape; the shaft of the penis slender throughout, without basal lobules or expansions (tip broken off).

Head and thorax with fine and scattered punctures, which are a little larger on the frons and on the posterior fourth of the mesonotum; clypeus, tegulae, scutellum, postscutellum, anterior and posterior slopes of mesopleura, and metapleura almost impunctate; propodeum mostly smooth, the dorsal areas posteriorly and the ventral areas with a few fine punctures. Abdomen with extremely minute, scattered punctures, especially small on the horizontal portion of the first tergite (which is almost impunctate under the hand-lens); punctures much more distinct and numerous (although no larger) before the apex of the second and following segments. Body covered with a short, silky, silvery white, appressed tomentum, especially noticeable on the clypeus, pleura and propodeum, without longer pubescence.

Black, with the following areas ivory-white (Ridgway's cream color): clypeus (except for a narrow median mark in the lower half, filling the bottom of the preapical groove); a wedge-shaped spot on the inter-antennal ridge down to the clypeus; very narrow inner orbits from the clypeus to the bottom of the ocular sinuses; a narrow streak on the swollen, upper part of the cheek (some distance behind the outer orbit); a large streak on the mandibles; dorsal anterior margin of pronotum very narrowly; anterior and posterior portions of tegula; raised lower portion of the inferior ridge of the propodeum; an elongate, vertical spot beneath the tegula, covering the hind portion of the upper plate of the mesepisternum; a narrow, continuous fascia along the hind margin of the scutellum, reaching the insertions of the wings; a narrow apical fascia on the first abdominal tergite; a broader apical fascia, somewhat dilated on the sides, on the second tergite and sternite; a very narrow apical fascia, not reaching the sides, on the third tergite; a spot near the apices of the front and middle femora; a line along the outer side of the front and middle tibiae (dilated near the apex of the former); and an elongate spot on the outer basal half of the hind tibiae. Anterior half of fore wing strongly infuscate with a purplish tinge (over most of the costal, the apical half of the median, the entire radial and most of the four cubital cells); remainder of the wings moderately smoky to subhyaline; stigma and veins dark brown.

SANTO DOMINGO: One male, holotype, without more definite locality (M. C. Z.).

Ancistrocerus (Parancistrocerus) atkinsi, new species.

A small, cylindrical species. Black, with numerous lemon yellow markings on head and thorax, apical yellow fasciae on the first, second, fourth, and fifth abdominal tergites and the second tergite, and lateral yellow spots at the base of the second tergite.

Length (h. + th. + t. 1 + 2) : ♀, 7 mm.

Female.—Head, seen in front, circular; seen from above, transverse but long, less than twice as wide as long, not wider than the thorax;

occipital margin nearly straight. Vertex and cheeks margined throughout by a carina, which is well marked on the occiput but higher along the cheeks. Cheeks moderately wide and hardly swollen in their upper half, considerably narrowed at the lower third where the marginal carina forms a broadly rounded, obtuse angle. Inner orbits one and one-half times as far apart on the vertex as at the clypeus. Upper half of frons moderately swollen. Ocelli in a flattened triangle, the posterior ocelli distinctly farther apart than from the eyes. Interocellar area flat; vertex with a pair of minute hairy foveae far removed from the occiput. Antennae almost twice as far apart as from the inner orbits; the ridge between them rather bluntly raised in its lower half. Clypeus very broadly pyriform, a little wider than long, slightly convex basally, somewhat depressed medially in its apical half; the anterior, free portion about as long as the upper, interocular part; the truncate apex about one-fourth the greatest width of the clypeus, with a slight inward curve, preceded by a narrow, shiny, but not depressed area; lateral angles of apex somewhat projecting, blunt, each with a low ridge which continues more or less distinctly over the lower third of the clypeus. Antenna short; flagellum a little thickened in the apical half; scape slender, distinctly curved, a little less than half the length of the flagellum; third antennal segment rather short, but distinctly longer than the fourth; fourth, fifth, and sixth almost square; seventh to eleventh wider than long; twelfth hardly longer than wide at the base. Mandible much shorter than the length of the eye, straight, ending in a short, obtuse tooth; inner margin with three superficial notches separating broad, low, blunt teeth. Thorax barrel-shaped, more distinctly narrowed posteriorly than anteriorly, one and one-half times as long as its greatest width and about as high as wide. Pronotum distinctly narrowed toward the anterior margin, which is squarely truncate and carinate; on the sides the carina is high and runs from the sharp humeral angles to the coxa; dorsally it is much finer and broadly interrupted in the middle; the carina forms the humeral angles which, however, are not raised or projecting. Mesonotum a little longer than wide, pentagonal in outline with the anterior third produced; very slightly convex, with slight traces of notauli close to the scutellum. Tegula about as wide as long, with broadly rounded outer margin, of normal shape; posttegula rather large, rectangular, very slightly curved. Scutellum rectangular, one and one-half times as wide as long, flat in its anterior half, somewhat raised posteriorly where it bears a fine, median, longitudinal impression, without tubercles or carinae; the deep sutures separating it from mesonotum and postscutellum finely and regularly foveolate. Postscutellum transversely elliptical, about half as long as the scutellum, moderately convex throughout and somewhat sloping posteriorly, without ridges, tubercles, or depressions. Mesepisternal suture continuous; epicnemial carina distinct, though blunt, beginning at the mesepisternal suture and extending to near the base of the middle coxa. Propodeum moderately long, squarely and vertically truncate behind, hardly swollen on the sides; dorsal areas touching each other in the middle over an extremely short, depressed space which distinctly separates the postscutellum from the concavity; concavity

wide, shallowly depressed, divided throughout by a fine longitudinal carina which does not attain the upper edge and is not connected with the superior ridges; superior ridges barely carinate, but with a series of sharp serrulations, those of the extreme upper edge not much stronger than the others; lateral and inferior ridges rounded; lateral angles not produced, broadly rounded. Abdomen elongate, moderately slender. First tergite short, transverse, cup-shaped in outline with rounded sides, about one and one-half times as wide as long and a little narrower than the second; its horizontal face, in profile, more than half the length of the second tergite; its anterior face sloping rather abruptly, but not forming a distinct angle with the posterior, horizontal portion; the two areas separated by a sharp, but rather irregular, transverse carina which appears to be produced by a series of very coarse punctures rather than by a formal ridge; its horizontal area much wider in the middle than on the sides, without median depression; its hind margin slightly thickened, somewhat produced in the middle, covering the depressed base of the second tergite; its extreme edge narrowly translucent and somewhat jagged. Second segment broadly barrel-shaped, somewhat more narrowed anteriorly than posteriorly, slightly wider than long, moderately and about equally convex dorsally and ventrally; its apical margin simple, without raised or depressed lamella, very slightly thickened and narrowly translucent along the extreme edge; its sternite gradually sloping and broadly rounded anteriorly, with a median longitudinal furrow in the basal third, and a row of pronounced, longitudinal riblets in the transverse furrow behind the basal articulation. The depressed basal neck of the second tergite forms no mite chamber. Legs rather slender, of normal shape. Wing venation: radial cell rather abruptly and considerably widened opposite the second cubital, very broadly rounded at the apex, not appendiculate; third cubital much higher than long.

Head and thorax densely covered with deep and large punctures, which are somewhat smaller and sparser on the upper half of the clypeus, between the antennae, in the sinus of the eye, on the cheeks, and on the mesopleura; lower half of the clypeus with large but rather superficial punctures, separated by irregular, faint striae; concavity of propodeum rugoso-reticulate in the upper half, densely and coarsely punctate in the lower half; tegulae and posttegulae impunctate. First abdominal tergite very coarsely and densely punctate; the punctures deeper and larger toward the transverse carina; behind the large, foveolate punctures that limit the carina there is, on each side, a narrow, irregular, impunctate space. Remainder of abdomen with fine and sparse, but distinct punctures which are stronger dorsally than ventrally and denser in the apical third of the second tergite. Body shiny, almost bare; head and thorax with extremely short, grayish pile.

Black. Basal half of clypeus (squarely emarginate with black anteriorly), a wedge-shaped spot between the antennae, the whole of the ocular sinuses, most of the upper half of the cheeks, a spot on the base of the mandibles, entire scape of antenna, anterior half of pronotum (not interrupted in the middle), a large, square, median spot in the posterior third of the mesonotum, postscutellum, tegulae, post-

tegulae, most of the dorsal and ventral areas of the propodeum (the yellow extending over the lateral angles to cover the lower sides of the concavity), upper plate of mesepisternum, apical margin of first tergite (very wide in the middle and gradually narrowed toward the sides), a broad apical margin on second tergite and sternite (somewhat wavy anteriorly), an oval spot on each side of second tergite very close to the base, broad apical fasciae on fourth and fifth tergites (ending far from the sides), and most of the legs, bright lemon yellow (Ridgway's lemon chrome). Flagellum of antenna ferruginous brown, dorsally darker; apical half of mandibles and much of the tarsi ferruginous. Coxae, trochanters, and hind femora (except extreme tip), black. Wings subhyaline, more infuscate in the radial cell which is slightly purplish; median cell mostly amber yellow; stigma amber yellow; veins brown, more yellowish toward the dorsal margin.

CUBA. La Milpa near Cienfuegos, July 4, 1925, one female, holotype (George Salt.—M. C. Z.). San Diego de los Baños, April, one female, paratype (Palmer and Riley.—U. S. N. M.).

Ancistrocerus (Parancistrocerus) lutzi, new species.

A small, cylindrical species. Black, with numerous pale yellow markings on head and thorax, pale yellow apical fasciae on the first, second, fourth, fifth, and (in the male) sixth abdominal tergites, and on the second and third sternites, and lateral yellowish dots at the base of the second or first and second tergites.

Length (h. + th. + t. 1 + 2): ♀, 6 to 6.5 mm.; ♂, 4.5 to 6 mm.

Female.—Head, seen in front, circular; seen from above, transverse but long, less than twice as wide as long; occipital margin with a decided inward curve. Vertex and cheeks margined throughout by a carina which is low but distinct on the occiput and very high along the cheeks. Upper half of the cheeks narrower than in *A. dejectus* (Cresson), but more swollen, gradually narrowed at the lower third where the carina forms no angle. Eyes one and one-third times as far apart on the vertex as at the clypeus. Upper half of the frons moderately swollen. Ocelli in a flattened triangle; posterior ocelli distinctly farther apart than from the eyes. Interocellar area almost flat, very slightly raised near the posterior ocelli; vertex with a pair of minute, hairy foveae far removed from the occiput. Antennae almost twice as far apart as from the inner orbits; the ridge between them rather bluntly raised in its lower half, with a deep impressed line in its upper half. Clypeus broadly pyriform, about as wide as long, slightly convex basally, somewhat flattened medially in its apical half; its anterior, free portion about one and one-third times the length of the upper, interocular part; its truncate apex about one-fourth the greatest width of the clypeus, with a moder-

ately deep inward curve preceded by a narrow, shiny, but not depressed area; lateral angles of apex forming strongly projecting, blunt teeth in each of which ends a short, distinct ridge. Antenna short; flagellum very gradually thickened toward the apical half; scape slender, distinctly curved, much less than half the length of the flagellum; third antennal segment a little longer than the fourth; fourth slightly longer than wide; fifth almost square; sixth to eleventh a little wider than long; twelfth a little longer than wide at the base. Mandible of the usual shape, considerably shorter than the length of the eye, straight, ending in a broad, obtuse, slightly curved tooth; inner margin with three deep notches separating broad, low, blunt teeth. Thorax barrel-shaped, more distinctly narrowed posteriorly than anteriorly, one and one-half times as long as its greatest width and about as high as wide. Pronotum distinctly narrowed toward the anterior margin which is squarely truncate and carinate; on the sides the carina is high and runs from the sharp humeral angles to the coxae; dorsally it is much finer and broadly interrupted in the middle; the carina forms the humeral angles which, however, are not raised or projecting. Mesonotum a little longer than wide, pentagonal in outline with the anterior third produced, very slightly convex, with slight traces of notauli close to the scutellum, and with a fine, impressed, median, longitudinal line over the anterior third. Tegula slightly longer than wide, with broadly rounded outer margin, of normal shape; posttegula large, rectangular, not curved, flat. Scutellum rectangular, a little less than twice as wide as long, flattened throughout, with the merest trace of a median longitudinal line, without tubercles or carinae; the deep suture separating it from the mesonotum coarsely foveolate; the suture separating it from the postscutellum finely foveolate. Postscutellum transversely elliptical, nearly two-thirds the length of the scutellum, moderately convex throughout, slightly sloping posteriorly, without ridges, tubercles, or depressions. Mesepisternal suture continuous; epicnemial carina distinct, though blunt, beginning at the mesepisternal suture and extending to near the base of the middle coxa. Propodeum moderately long, squarely and vertically truncate behind, hardly swollen on the sides; dorsal areas touching each other in the middle over an extremely short, depressed space which distinctly separates the postscutellum from the concavity; concavity wide and rather deep, divided throughout by a fine longitudinal carina which expands and divides at the upper edge to join the superior ridge on each side; superior ridges very finely and irregularly carinate, the carina higher and somewhat wavy in the upper part but not forming a sharp crest; lateral ridges rounded; inferior ridges somewhat angular but not carinate; lateral angles indistinct, in profile slightly more projecting than the upper edge of the superior ridge, broadly rounded. Abdomen elongate, quite slender. First tergite short, transverse, cup-shaped in outline with rounded sides, about one and one-half times as wide as long and a little narrower than the second; its horizontal face, in profile, more than half the length of the second tergite; its anterior, vertical face sloping abruptly but not forming a distinct angle with the posterior, horizontal portion; the two areas separated by a sharp, rather irregular, transverse carina which

appears to be produced by a series of foveolae rather than by a formal ridge, and which is more marked on the sides than in the middle; its horizontal area slightly wider in the middle than on the sides, without median depression; its hind margin hardly thickened, not produced in the middle, covering the depressed base of the second tergite; its extreme edge narrowly translucent and somewhat jagged. Second segment broadly barrel-shaped, somewhat narrower anteriorly than posteriorly, a little wider than long, moderately and about equally convex dorsally and ventrally, not ending in a depressed lamella; its apical margin slightly thickened and preceded by a distinct, though shallow transverse groove; its extreme edge narrowly translucent and serrulate; the anterior limit of the preapical groove with a low but distinct, somewhat transverse swelling on each side of the middle line; its sternite gradually sloping and broadly rounded anteriorly, with a median, longitudinal furrow in its basal third, with a row of pronounced longitudinal riblets in the transverse furrow behind the basal articulation, and with a slight transverse swelling on each side a short distance from the apical margin (less pronounced than that of the tergite). The depressed basal neck of the second tergite forms no mite chamber. Legs rather stout, of normal shape. Wing venation: radial cell gradually but rather considerably widened opposite the second cubital, broadly rounded at apex, with a stump of appendicular vein; third cubital much higher than long.

Head densely covered with coarse punctures which are finer on the interocellar area and on the cheeks; raised interantennal area, lower inner orbits, and ocular sinuses without coarse sculpture, smooth under the hand-lens but with an extremely fine, microscopic puncturation. The punctures of the clypeus medium-sized and scattered, somewhat more numerous than in *A. dejectus;* the irregular, longitudinal striation of the lower half more distinct than in that species. Dorsal surface of thorax uniformly covered with dense and coarse punctures, leaving no smooth intervening spaces except in the center close to the scutellum; the punctures a little more distinct on the scutellum and much smaller and sparser on the postscutellum and mesopleura; anterior and posterior slopes of mesopleura, metapleura, and sternum almost impunctate. Tegulae and posttegulae without coarse sculpture, but densely covered with microscopic punctures. Dorsal areas of propodeum reticulato-punctate; ventral areas with scattered, medium-sized punctures; sculpture of concavity as in *A. dejectus*. First abdominal tergite sculptured as in *A. dejectus*, but the puncturation of the remainder of the abdomen much stronger and more abundant, especially on the sides and in the preapical, shallow grooves of the second tergite and sternite. The disk of the third sternite almost entirely covered with a maze of large, deep pits. Body shiny. Head with short, grayish pile; thorax and abdomen with short, silvery pubescence which is densest and longest over the pitted disk of the third sternite.

Black. Basal third of clypeus (arcuately emarginate with black anteriorly), an elongate median spot on the frons above the insertion of the antennae, whole of the ocular sinuses, a narrow elongate spot on the upper half of the cheeks, broad under side of the antennal scape, a

small triangular spot on the base of the mandibles, anterior third of pronotum (broadly interrupted in the middle), a large, rectangular, median spot in the posterior third of the mesonotum, postscutellum, tegulae, posttegulae, large lateral spots on the propodeum (covering the lateral angles and the inferior ridges and extending somewhat over the dorsal and lateral areas and the sides of the concavity), upper plate of the mesepisternum, apical margin of first tergite (very slightly wider in the middle), a small, transverse, lateral spot on each side of the first tergite behind the carina, apical margin of second tergite and sternite, a round spot on each side of the second tergite a little distance from the base, apical fasciae on the fourth and fifth tergites (not reaching the sides) and on the third sternite, apical fourth of the front and middle femora, a dot at the apex of the hind femora, and most of the outer side of all the tibiae, pale yellow (Ridgway's pinard to empire yellows). Under side of flagellum, apex of mandible, and tarsi more or less ferruginous; a pale ferruginous spot in the center of the tegulae. Wings subhyaline, more infuscate and slightly purplish in the radial cell; costa pale brown, the other veins and the stigma dark brown.

Male.—Very similar in structure and sculpture to the female, except for the following points. Cheeks narrower in their upper half, narrower but somewhat more swollen than in the male of *A. dejectus*. Eyes a little less than twice as far apart on the vertex as at the clypeus. Interocellar area with a slight longitudinal depression and distinctly raised beside the posterior ocelli. Vertex without foveae. Clypeus pentagonal with rounded edges, moderately convex, with a little swelling on each side above the middle, about as wide as long; its apical, free portion about as long as the basal, interocular part; its apex deeply, almost semicircularly emarginate, forming two narrow, triangular, blunt teeth (the emargination appears to be much deeper owing to a preapical, translucent depression). Antenna more slender; flagellum slightly thickened in the apical half; scape less than one-fourth the length of the flagellum; third and fourth antennal segments much longer than wide and of about equal length; fifth a little shorter than fourth; sixth to eleventh a little longer than wide; twelfth small; thirteenth (hook) finger-shaped, longer and narrower than in *A. dejectus*, slender, slightly curved, the rather narrow but blunt tip reaching the apex of the tenth segment. Humeral angles sharper and slightly more projecting than in the female. Preapical transverse groove of the second tergite more distinct, as are also the transverse swellings of second tergite and sternite. Clypeus with fine scattered punctures, visible with the hand-lens, without striae. The pits which cover the disk of the third sternite even larger and deeper than in the female.

The pale yellow markings differ from those of the female as follows: clypeus entirely yellow; frontal spot between the insertions of the antennae extending to the clypeus; spot in the ocular sinus continuing some distance along the lower inner orbit; outer surface of mandible almost entirely yellow; lateral spots of propodeum much smaller or lacking; lateral spots of first tergite sometimes absent; sixth tergite also with an apical fascia (not reaching the sides); femora more extensively yellow; middle and hind coxae with a large yellow spot beneath.

SANTO DOMINGO. Fond Parisien, Haiti, one female, holotype, one male, allotype, and four males, paratypes, February 11 to 18, 1922; Port-de-Paix, Haiti, one female, paratype, October 25, 1923 (A. M. N. H.). Port-au-Prince, Haiti, one male, paratype (G. N. Wolcott.—U. S. N. M.).

Ancistrocerus (Parancistrocerus) olseni, new species.

A medium-sized, moderately slender species. Black, with numerous yellow markings on head and thorax, yellow apical fasciae on the first and second tergites and second sternite, and yellow spot, near the base of the second tergite, and with the propodeum, first abdominal tergite, and legs partly ferruginous red.

Length (h. + th. + t. 1 + 2): ♀, 8 mm.

Female.—This species is structurally so close to *A. obliquus* (Cresson) that it will suffice to point out the differences. Third antennal segment one and one-half times the length of the fourth. Anterior margin of pronotum dorsally with an extremely fine, translucent carina which is very broadly interrupted in the middle (the median fourth of the margin smoothly rounded) and which runs over the humeral angles; laterally the carina is high and extends to the base of the coxa. Humeral angles much more prominent, their sharp apices somewhat curved outwardly. Posttegula broader, rectangular with rounded apex, not curved. Sides of postscutellum slightly raised into low, smooth swellings. Epicnemial carina well marked in the lower half, gradually effaced toward the mesepisternal suture. Dorsal areas of propodeum more broadly contiguous in the middle line, the concavity more distant from the postscutellum. Abdomen more stubby. First tergite relatively wider and shorter, only slightly narrower at the apex than the base of the second; its horizontal face about one and one-half times as wide as long, separated from the anterior, sloping face by a much finer, irregular, but well-defined and straight carina; apical margin not covering a mite chamber at the base of the second tergite. Second segment more strongly swollen dorsally and ventrally, the hump on the tergite more pronounced and situated more anteriorly.

The puncturation is totally different from that of *A. obliquus*. Head and thorax almost entirely covered with very coarse and dense punctures, the narrow lines separating them forming an irregular striation in the posterior third of the mesonotum; the punctures fine but numerous on the vertex, cheeks, scutellum, postscutellum, mesopleura, and ventral areas of the propodeum; even finer and less abundant on the upper half of the clypeus, upper plate of mesepisternum, metapleura and tegulae; sinuses of the eyes and interantennal area smooth and impunctate. On the apical half of the clypeus the irregular longitudinal striation is better defined than in *A. obliquus*. Concavity and dorsal areas of propodeum very coarsely rugoso-punctate, the

rugosities tending to form transverse striae over the rounded superior ridges. Puncturation of first abdominal tergite, behind the carina, very coarse and more or less reticulate in the anterior half, medium-sized in the middle, much finer in the apical third. The punctures of the remainder of the abdomen much finer and sparser than elsewhere on the body, though larger and more numerous than in *A. obliquus*. Pubescence as in *A. obliquus*.

Black. The following parts bright yellow (Ridgway's lemon chrome): basal three-fifths of the clypeus, a wedge-shaped spot between the antennae, whole of the ocular sinuses, major part of the cheeks, a triangular spot at the base of the mandibles, scape of the antennae, anterior half of pronotum, most of scutellum and postscutellum, tegulae, posttegulae, a broad spot in the upper half of mesopleura, sides of propodeum (less extensively than in *A. obliquus*), apical margin of first tergite (gradually widened toward the middle), broad apical margin of second tergite and sternite, a triangular spot on each side at the base of the second tergite, most of the apical half of front and middle femora, and most of the tibiae. Base and under side of flagellum, apex of mandible, most of dorsal areas of propodeum (continued laterally), most of metapleura, basal half of first tergite, first sternite, base of second sternite, coxae, trochanters, basal half of front and middle femora, hind femora, inner side and apex of tibiae, and tarsi, ferruginous to reddish brown (Ridgway's burnt sienna to mahogany). Wings in their basal two-thirds subhyaline with a distinct amber yellow tinge, the veins of that part and the stigma also yellowish; apical third smoky and distinctly purplish, the veins dark brown.

BAHAMAS. Mangrove Cay, Andros Island, one female, holotype, June 24, 1924 (C. E. Olsen.—M. C. Z.).

Odynerus (Rygchium) haitiensis, new species.

A medium-sized, stubby species. Ferruginous red, with numerous yellow markings on head and thorax and yellow apical fasciae on some of the abdominal segments.

Length (h. + th. + t. 1 + 2): ♀, 10 mm.

Female.—Head, seen in front, subcircular, about as high as wide; seen from above, transverse, less than twice as wide as long; occipital margin almost straight. Vertex and cheeks margined throughout by a sharp carina, which is somewhat higher on the occiput. Cheeks wide and distinctly swollen in their upper half, where they are about as wide as the upper part of the eye in profile, gradually narrowed in their lower third; the marginal carina broadly rounded, not forming an angle. Inner orbits very little farther apart on the vertex than at the clypeus. Upper half of the frons hardly swollen. Ocelli in a flattened triangle; posterior pair about as far apart as from the eyes and about twice as far from the occipital margin as from each other. Interocellar area flat. Vertex with a pair of minute foveae a short distance from

the occipital margin. Antennae a little farther apart than from the inner orbits; area between them moderately raised into a uniform, blunt ridge; from the upper end of the ridge a fine impressed line extends to a minute, smooth pit in the middle of the frons. Clypeus broadly pyriform, about as wide as long, moderately convex, slightly flattened in the middle over its apical half; its anterior, free portion as long as the upper, interocular part; its truncate apex about one-third of the greatest width of the clypeus, with a very slight inward curve, forming right angles with the lateral margins; lateral angles of apex hardly projecting, sharp, and somewhat raised longitudinally. Antenna short; flagellum almost uniformly swollen throughout; scape slender, a little over one-third the length of the flagellum, distinctly curved; third antennal segment about one and one-half times the length of the fourth; fourth almost square; fifth to eleventh slightly wider than long; twelfth about as long as wide at the base. Mandible much shorter than the length of the eye, stout, straight; apex forming a blunt, slightly curved tooth; inner margin with three notches separating broad, low, blunt teeth. Maxillary palpi of six segments, the three terminal segments long and slender, together much longer than the third. Labial palpi of four segments, the fourth a little over one-third the length of the third. Thorax rectangular, stubby, very slightly and equally narrowed anteriorly and posteriorly, a little over one and one-third times as long as its greatest width and about as wide as high. Pronotum slightly narrowed toward the anterior margin, which shows a deep but regular inward curve and bears a continuous, sharp, transverse carina, raised dorsally into a somewhat translucent lamella and continued over the humeral angles to the coxae; humeral angle bluntly rounded but distinct, not projecting anteriorly and emitting no carina toward the hind margin of the pronotum. Mesonotum distinctly longer than wide, pentagonal in outline with the anterior third produced and the anterior angle broadly rounded, almost flat; without notauli. Tegula very little longer than wide, its hind margin forming a continuous curve with the outer margin; posttegula very small, finger-shaped, straight. Scutellum rectangular, about twice as wide as long, almost flat, with a faint trace of an impressed, median, longitudinal line, without tubercles or carinae; suture separating it from the mesonotum minutely foveolate. Postscutellum transversely elliptical; seen from above, about half the length of the scutellum, without depression or tubercles; moderately swollen throughout, with a short, anterior, horizontal area and a longer, vertical, posterior portion; the two areas separated by a finely crenulate ridge, which is somewhat lower in the middle. Mesepisternal suture continuous; epicnemial carina only faintly indicated in its lower portion. Propodeum short, squarely and vertically truncate behind, hardly swollen on the sides; dorsal areas very broadly separated from each other by the postscutellum, the vertical face of which is continuous with the concavity; concavity wide and shallowly depressed, divided in the middle by a smooth, longitudinal carina, which is broad in the lower half and fine in the upper half where it reaches the postscutellum; superior ridge well marked, with a fine, irregular carina which is

separated from the postscutellum by a broad shallow notch; lateral and inferior ridges broadly rounded; lateral angles prominent but low, very obtuse and somewhat jagged. Abdomen short and rather stubby. First tergite transverse, longer than usual, less than twice as wide as long in the middle, as wide as the base of the second segment; in outline cup-shaped with rounded anterior angles; its horizontal face in profile over half the length of the second tergite; its anterior slope forming a bluntly rounded right angle with the posterior, horizontal portion; its horizontal part distinctly wider in the middle than on the sides, without depression; the hind margin not thickened, simple. Second segment about as wide as long and almost parallel-sided; not contracted toward the base; moderately and about equally convex dorsally and ventrally; the apical margin simple, without raised or depressed lamella; the sternite gradually sloping basally, with a deep, median, longitudinal furrow near the base, the transverse basal furrow without longitudinal ridges, but separated from the articulation by a broad, smooth space; the surface of the tergite very slightly swollen on each side some distance from the apical margin. Legs very stout; tibiae much swollen, especially those of the hind legs; inner tooth of claw placed close to apex. Wings with the *Odynerus*-type of venation; radial cell rather shorter than usual, slightly and very gradually widened opposite the second cubital, broadly rounded at apex, without trace of appendiculate vein; third cubital higher than long.

Head mostly covered with an exceedingly fine, close and irregular puncturation, which gives it a dull, somewhat granular appearance; punctures more distinct on the cheeks; those of the clypeus larger (especially in the middle), much scattered, not separated by striae. Thorax with fairly uniform, medium-sized, moderately dense puncturation, which is very sparse below the humeral angles and on the ventral areas of the propodeum; tegulae, anterior and posterior (sloping) faces of mesopleura, and metapleura, impunctate, smooth. Concavity of propodeum impunctate, very finely and transversely striate in its lower half, almost smooth in its upper half. First tergite with fine, scattered punctures, which are very sparse in the middle, more abundant posteriorly, and much larger on the sides. On the second and succeeding tergites the puncturation is very fine, moderately dense, and fairly uniform; it is more distinct but sparser on the corresponding sternites. Body dull, especially the vertex and dorsum; clypeus and concavity of propodeum more shiny. Pilosity very sparse and short, brownish gray; the gula with longer, somewhat recurved hairs.

Ferruginous red (Ridgway's Sanford's brown); with inner margin and apex of mandible, a spot above the insertion of each antenna, a median dot on the frons, anterior sloping face of mesopleura, sutures of pleura and of scutellum and postscutellum, a median stripe in the upper half of the concavity of the propodeum, and extreme base of second tergite, brown to blackish; flagellum infuscate above. The following parts are bright lemon-yellow (Ridgway's light cadmium): sides of clypeus; a wedge-shaped spot between the insertions of the antennae; a round, median spot below the anterior ocellus; inner orbits

(filling the sinuses of the eyes completely); most of the cheeks (connecting with the inner orbits and somewhat expanded over the vertex); under side of scape; much of the mandibles; a broad fascia on the anterior margin of the pronotum, continued narrowly on the sides to near the front coxae; four longitudinal stripes on the mesonotum (one pair very short, close to the tegulae; the other longer, curved, situated medially, not reaching the scutellum); most of the scutellum and postscutellum; tegulae (except for a median ferruginous spot); most of the mesopleura; dorsal areas, lateral angles, and inferior ridges of the propodeum; a broad apical fascia on the first and second tergites and on the second sternite (that of the first tergite continuing along the sides to near the base; that of the second sternite connected with a median spot); much narrower apical fasciae on the third and fourth tergites and sternites, widened in the middle on the sternites; under side of the coxae and front and middle femora; tibiae entirely; and most of the tarsi. Wings subhyaline, strongly tinged with amber yellow throughout, very slightly purplish toward the apex; stigma and veins yellowish brown; costa and subcosta more ferruginous.

SANTO DOMINGO. Grande Anse, Haiti, one female, holotype (P. R. Uhler.—M. C. Z.).

Pachodynerus scrupeus (Zavattari) var. **bahamensis,** new variety.

Female.—Black. Most of the mandibles, labrum, apical margin of the clypeus, a line on the under side and extreme apex of the scape, second and third as well as under side of fourth antennal segments, a median spot on the tegulae, basal half of first abdominal tergite and sternite, last sternite, most of legs (including the coxae and excepting the yellow markings), ferruginous to reddish brown (Ridgway's burnt sienna to mahogany). The following parts are bright lemon-yellow (Ridgway's lemon chrome): a small triangular spot at the base of the mandible; basal two-thirds of the clypeus, deeply indented by a sagittate, median, black spot; a triangular spot in the lower part of the frons above the insertion of the antennae (not extending to the base of the clypeus); most of the scape; anterior half of the pronotum; most of the tegulae; posttegulae; two triangular, lateral spots on the scutellum; a broad fascia over the anterior half of the postscutellum; sides of propodeum (slightly less extensively than in typical *P. scrupeus*); upper plate of mesepisternum; broad apical margins on first tergite and second tergite and sternite (narrower than in the typical form and not invading the sides of the horizontal portion of the first tergite); under side and apex of front and middle femora; apex of hind femora; and outer side of tibiae. Wings as in the typical form.

BAHAMAS. Mangrove Cay, Andros Island, one female, holotype, August 1, 1904 (M. C. Z.).

Pachodynerus (Pachodynerus) jamaicensis, new species.

Odynerus tibialis Fox, 1891, Trans. Amer. Ent. Soc., XVIII, p. 343 (♀). Ashmead, 1900, Trans. Ent. Soc. London, p. 312 (in part). Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. 4, pts. 1–2, p. 95. Not *O. tibialis* H. de Saussure, 1852.

Odynerus guadulpensis Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. 4, pts. 1–2, p. 95. Not *O. guadulpensis* H. de Saussure, 1852.

A medium-sized, stubby species. Black, with numerous lemon yellow markings on head and thorax, and yellow apical fasciae on the first two segments of the abdomen.

Length (h. + th. + t. 1 + 2); ♂, 7 to 8 mm.

Male.—Head, in front view, subcircular, about as high as wide; seen from above, transverse, about twice as wide as long, not wider than the thorax. Occipital margin with a distinct though shallow inward curve. Vertex and cheeks margined throughout by a sharp carina which is as high on the occiput as along the cheeks. Cheeks of moderate width, very slightly swollen in their upper half, where they are about half as wide as the upper part of the eye in profile; gradually narrowed in their lower half, the carina not forming an angle. Inner orbits about one and one-third times as far apart on the vertex as at the clypeus. Upper half of frons very little swollen. Ocelli in a flattened triangle; the posterior pair a little farther apart than their distance from the eyes, much farther from the occipital margin. Interocellar area with a distinct, longitudinal depression which, however, is not bordered by lateral swellings. Vertex without basin, fovea, or ridge. Antennae twice as far apart as their distance from the eyes, the ridge between them well developed, sharply carinate throughout. Clypeus irregularly hexagonal, slightly higher than its greatest width, which is a little below the middle, very slightly and uniformly convex throughout, with faint indications of two longitudinal swellings above the middle; its lower, free portion little shorter than the upper, interocular part; its truncate apex very broad, about one-third the maximum width of the clypeus, almost straight, the apical edges not projecting but forming sharp, somewhat ridged, right angles. Antenna short; flagellum slightly and very gradually swollen toward the apical third; scape short, less than one-third the length of the flagellum, slightly curved; third antennal segment about one and one-half times as long as the fourth; fourth to ninth longer than wide; tenth nearly square; eleventh slightly longer than wide at base, with the minute twelfth protruding from its truncate apex. Mandible much shorter than the length of the eye, straight; apex blunt and slightly curved; inner margin divided by four very shallow notches producing very broad, blunt teeth of unequal size: the first and third from the base extremely low, barely indicated, the second and fourth stronger and about equally prominent (although the second is a little sharper than the fourth, it is much wider at its base than it is high). Thorax stubby, barrel-shaped, very slightly and about equally narrowed anteriorly and posteriorly, a little longer than wide (the width is about equal to the distance between the anterior margin of the pronotum and the posterior margin of the scutellum), a little

wider than high. Pronotum moderately narrowed toward the anterior margin which is strongly curved inwardly and carinate throughout; the carina higher dorsally than on the sides, forming a low, translucent lamella which runs over the humeral angles; below the humeral angle the carina bifurcates, sending out a fine, sharp, not lamellate ridge to the hind margin of the pronotum; humeri forming right angles, but not pointed or projecting; the smooth anterior face without pits. Mesonotum slightly wider than long, almost regularly pentagonal in outline with broadly rounded anterior margin, moderately but decidedly convex, without notauli, with a fine, impressed, median line in the anterior third. Tegula much longer than wide, of normal shape, the outer and hind margins forming one continuous curve; posttegula narrow, short, straight, finger-shaped, with blunt apex. Scutellum rectangular, about twice as wide as long, moderately convex throughout, without tubercles, carinae, or impressions; the deep anterior and posterior sutures not foveolate. Postscutellum semi-elliptical with the anterior margin straight, about one-half the length of the scutellum; its anterior horizontal area about as long as the posterior, vertically sloping portion (part of the concavity of the propodeum); the passage between them rounded, without transverse ridge, superficially crenulate and without median depression; without tubercles. Mesepisternal suture continuous; epicnemial carina beginning at the mesepisternal suture and bifurcating in the lower half, the two branches (of which the anterior is the stronger) running across the sternum to meet their fellows from the other side. Lower edge of mesepimeron slightly produced downward into a short, blunt tooth; upper hind edge of metapleuron slightly raised into a low, triangular spine. Propodeum short, squarely and vertically truncate behind, moderately swollen on the sides; dorsal areas very broadly separated in the middle by the vertical face of the postscutellum; concavity wide and shallow, divided in its upper third by a fine, longitudinal carina which reaches the hind margin of the postscutellum, in its lower two-thirds with a median, flattened, smooth area; superior ridges raised into low but sharp, partly translucent lamellae which form a triangular, flattened, blunt tooth at each lateral angle, the ridges not curved inward behind the postscutellum from which they are separated by a broad depression but not by an abrupt notch; inferior ridges broadly rounded; lateral ridges bluntly angular but not carinate; lateral angles moderately produced, each bearing the lamellar tooth of the superior ridge. Abdomen short and very stubby. First tergite short and transverse, without median depression; in outline cup-shaped with rounded sides; a little more than twice as wide as long; its posterior, horizontal area in profile about half the length of the second tergite, forming a blunt, abrupt angle with the anterior, vertical area, the passage between the two areas distinctly swollen (with a slight median depression), although not forming a true ridge or suture; its hind margin not thickened, slightly produced in the middle, very narrowly translucent along the edge. Second tergite almost rectangular, distinctly wider than long, very little narrowed anteriorly where it is as wide as the apex of the first tergite, very slightly and evenly convex; the apical margin simple, flat, very narrowly translucent along the

extreme edge; second sternite in profile considerably depressed or slightly concave before the middle, angular anteriorly where it slopes vertically to the smooth, transverse, basal furrow and has no median, longitudinal furrow. Legs rather slender, of normal shape. Genitalia: shaft of penis slender in its apical fourth only, then rather rapidly widened to a very broad base; lobules long and narrow, broadly rounded apically and slightly produced into a basal angle (best seen in profile); margin of lobule simple, not denticulate; lobules fairly distant from the apophyses. Wing with the usual type of venation, very little different from that of *P. cubensis*, except that the third cubital cell is as high as long and about equally long on the radius and the cubitus.

Head and thorax densely and uniformly covered with coarse punctures which are finer on the cheeks and on the lower part of the face. Punctures of the clypeus, as seen with a hand-lens, very fine and sparse, scattered uniformly over the surface. Mandibles, tegulae, anterior and posterior faces of the mesopleura, and metapleura almost impunctate. Lateral areas of propodeum entirely covered with large, sparse punctures of unequal size; concavity in its upper third with large, irregular pits, in its lower two-thirds with heavy, transverse, slightly wavy ribs; dorsal areas subreticulate, with very heavy punctures. Much of the integument of the abdomen is either alutaceous or densely covered with microscopic punctures; in addition the dorsal surface has extremely sparse, fine punctures which are a little deeper and more numerous before the apex of the first and second tergites and even more numerous and coarser on the succeeding tergites; the horizontal area of the first tergite also bears coarse, scattered punctures which are denser on the sides and behind the basal, transverse swelling (this coarser puncturation of the first tergite is not present in the allied West Indian species *P. tibialis* and *P. guadulpensis*); sternites with scattered punctures, somewhat more numerous than on the tergites, the puncturation much coarser on the basal third of the second sternite. Head and thorax with short, sparse, erect, brownish gray hair; abdomen with very sparse, erect hair and short, appressed pubescence, blackish on part of the dorsal surface, finer and grayish ventrally.

Black. Most of mandibles, center of tegulae, extreme base of first abdominal segment, and legs (except coxae), pale ferruginous red; under side of flagellum somewhat ferruginous; legs somewhat blotched with dirty yellow, especially on the under side of the tibiae and toward the apex of the femora. The following markings are bright lemon yellow (Ridgway's lemon chrome): a large triangular spot at the base of the mandible; labrum; clypeus; a narrow streak along the lower inner orbits (barely entering the ocular sinuses); anterior face of scape; anterior half of pronotum; two spots on the tegula; posttegulae; anterior two-thirds or more of postscutellum; most of the upper plate of mesepisternum; a broad stripe on each side of the propodeum (covering most of the dorsal and lateral areas, but not entering the concavity); and a broad apical fascia on the first tergite and on the second tergite and sternite (that of the first tergite gradually widened toward the sides). Wings subhyaline, with an amber yellow tinge which is more pro-

nounced in the anterior half of the fore wing; radial cell slightly darker and somewhat purplish; veins and stigma yellowish brown.

Female.—Structure and sculpture of head, thorax, legs and wings as in the male, except for the following points. Cheeks relatively wider, almost two-thirds of the width of the upper part of the eye in profile. Inner orbits about one and one-fifth times as far apart on the vertex as at the clypeus. Upper half of frons distinctly swollen. Interocellar area very faintly depressed. Vertex with a small, transverse fovea. Clypeus broadly pyriform, about as wide as high, very slightly convex, somewhat flattened in the middle over its apical half (the flattened portion limited on each side by a very blunt, low ridge); its lower, free portion about as long as the upper, interocular part; its truncate apex about one-third of the maximum width of the clypeus, with a very shallow, inward curve, the sides forming bluntly rounded, right angles. Antenna short, especially the flagellum, the scape being over one-third the length of the flagellum; fourth and fifth antennal segments nearly square; sixth to eleventh increasingly wider than long; twelfth about as long as wide at base. Inner margin of mandible with four superficial notches producing very broad, low and blunt teeth. Puncturation of clypeus fine and rather dense on the sides and in the upper third, much coarser but sparser in the median, flattened portion. (Abdomen lacking).

Coloration of head, thorax, legs and wings similar to that of the male; but clypeus yellow in its upper half, black in its lower half, the truncate apical margin ferruginous red.

JAMAICA. Montego Bay, St. James, two males, holotype and paratype, December 30, 1919, and January 1, 1930 (A. M. N. H.). Kingston, one female, allotype, April, 1891 (W. J. Fox and C. W. Johnson.—A. N. S. Phila.). Portland, two male paratypes; St. Andrews, one male, paratype; Two Mile Wood, St. Catherine, November 14, 1919, one male, paratype; Bath, St. Thomas, February 2, 1920, one male, paratype (U. S. N. M.).

Mischocyttarus bruneri, new species.

A moderately slender species, more stubby than *M. cubensis* (H. de Saussure). Black, with the head, scape of antennae, dorsal face of thorax, and abdomen behind the first segment, reddish brown; no pale markings.

Length (h. + th. + t. 1 + 2): ♀ or ☿, 8 to 9 mm.

Female or Worker.—Head much swollen; seen from above, broadly rectangular and a little less than twice as wide as long; seen in front, about as high as wide. Vertex and cheeks not margined by a carina behind. Cheeks well developed, about as wide in profile as the eye or even a little wider; oculo-malar space long, nearly the length of the sixth antennal segment. Inner orbits as far apart on the vertex as at the clypeus. Ocelli small, in an equilateral triangle; the posterior

ocelli about as far from the inner orbits as from the occipital margin, but much nearer to each other. Clypeus much wider than long, trapezoidal, rather narrowly contiguous with the inner orbits over a distance about equal to the length of the oculo-malar space; its anterior margin somewhat more projecting than in *M. cubensis*, being divided by deep notches from the lateral lobes, which also are quite pronounced and somewhat angular; the apex itself bluntly rounded. Eyes bare. Antenna rather stubby; scape short, about three times as long as thick at apex, and about as long as the two following segments together; third segment slightly longer than the fourth and fifth together; flagellum somewhat more swollen in the apical half than in *M. cubensis*. Thorax with the usual shape and structure of the genus. Anterior margin of pronotum straight, very slightly raised, not carinate; humeral angles, as seen from above, broadly rounded and not in the least projecting. Mesepisternal suture well-marked. Propodeum with a rather narrow longitudinal groove. First abdominal segment much narrower than the remainder of the abdomen, forming a moderately long and slender petiole, which is decidedly shorter and more swollen than in *M. cubensis;* about two and one-half times as long as its greatest width (at apex), considerably shorter than the thorax, and only slightly longer than the second tergite; basal half parallel-sided; apical third, seen from above, about two and one-half times as wide as the base into which it passes quite gradually; spiracles not protuberant on the sides; in profile gradually swollen to its apical third, where it is about twice as thick as at the base. Remainder of the abdomen short, oval, conspicuously broader than the petiole. Legs long and stout; femora more swollen than in *M. cubensis;* tibiae slender at base, broad in the apical half; digitiform processes on the inner side of the third and fourth segments of the middle and hind tarsi moderately long, those of the fourth segment not reaching half the length of the fifth segment; claws of middle and hind legs subequal in each pair; middle tibiae with two spurs.

Under a hand-lens the body appears to be impunctate, except on the median, apical lobe of the clypeus and on the mandibles, which bear a number of coarse, scattered pits. Under the microscope, however, the entire body is minutely alutaceous, the very close, extremely fine sculpture giving it a somewhat dull appearance. Body very finely pubescent; apex of clypeus with a few longer and stouter hairs; propodeum and base of abdomen more densely clothed with silvery gray pile; tarsi more coarsely hairy; under side of hind tibiae toward the apex with a short brush of shiny, tawny pile.

Head entirely dull reddish brown (Ridgway's mahogany red), with a darker spot of dull black about the ocelli; mandibles and tip of clypeus rather lighter, bright red. Upper part of prothoracic lobes, mesonotum, more or less of the scutellum, sometimes the anterior margin of postscutellum, and more or less of the mesepisternum, dull red (Ridgway's burnt sienna); remainder of thorax dull black. First abdominal segment black, except for a narrow, dark brown, apical margin; remainder of abdomen reddish brown (Ridgway's chestnut), without markings of any kind. Scape and pedicel of antenna dull dark red; flagellum dull black, with a suggestion of red at the extreme tip.

Legs largely black; tarsi dull brown; extreme base of hind femora, an indistinct line on middle and hind tibiae, and fore part of front tibiae, reddish. Wings clear, amber-colored; second and third cubital cells almost hyaline; median cell and stigma darker.

CUBA. Sierra Maestra, at 4,500 ft., July 10–20, 1922, two females or workers, holotype and paratype (O. H. Ballou and S. C. Bruner.—U. S. N. M.).

Polistes poeyi Lepeletier var. **haitiensis,** new variety.

Female and Worker.—Head reddish (Ridgway's chestnut), with the lower lateral margins and apex of the clypeus and the lower inner orbits (not entering the ocular sinuses) bright yellow (Ridgway's light cadmium). Vertex blackish about the ocelli; flagellum infuscate beyond the third antennal segment. Thorax mostly black; only the posterior half of the scutellum and a spot on each side of the pronotum (covering most of the dorsal aspect), reddish; with numerous yellow markings as follows: narrow anterior and posterior margins of the pronotum; a spot on the mesepisternum beneath the base of the wing; coxal processes of meso- and metapleura; tegulae; anterior half of scutellum; most of postscutellum; a very wide longitudinal stripe on each side of the median groove of the propodeum; and articular valvulae of abdomen. Abdomen ferruginous (Ridgway's burnt sienna) to brownish black, the base of the first tergite sometimes black; with continuous bright yellow apical bands on the first to fourth tergites and on the second and third sternites; bands of first and second tergites widened on the sides where they are produced anteriorly; the bands as wide as in typical *P. poeyi*. Coxae and most of femora black; femora brownish red in the apical half (especially above) and with an apical yellow spot (larger on the front and middle legs); tibiae reddish to brown on the inner side, extensively yellow on the outer side; tarsi yellow, the terminal segments mostly reddish on the middle and hind legs. Wings moderately infuscate, with a ferruginous tinge which is more pronounced than in typical *P. poeyi*.

Male.—Coloration similar to that of the female and worker, but mandibles mostly and inner orbits more extensively yellow (this color covers the lower half of the ocular sinuses); fourth abdominal sternite also and fifth tergite occasionally with an apical yellow band; front and middle coxae with a yellow spot on the under side; front and middle femora extensively yellow beneath; tarsi almost wholly yellow.

A careful study of the structural characters discloses no differences from the typical color phase of *P. poeyi* Lepeletier, of Cuba, a species which has thus far been called *P. minor*. The true *P. minor* P. de Beauvois (*P. hertwigi* Schulz) is, in our opinion, restricted to Santo Domingo, while *P. poeyi* occurs in both islands, though in distinct color phases.

SANTO DOMINGO. Bizeton, Haiti, January 9, 1922, one female or worker, holotype (A. M. N. H.). Haiti, without more

definite locality, March, 1925, one male, allotype (G. S. Miller.—U. S. N. M.). Azua, Rep. Dominicana, March, 1913, one female or worker, paratype (P. G. Russell.—U. S. N. M.). Port-au-Prince, Haiti, one male, paratype; Carrefour, Haiti, one worker or female, paratype; Fond Parisien, Haiti, one worker or female, paratype; Sanchez, Rep. Dominicana, one female or worker, paratype (A. M. N. H.).

Polistes crinitus (Felton) var. **insulicola,** new variety.

Polistes crinitus J. C. Hutson, 1918, West Indian Bull., Barbados, XVI, 4, p. 322. Not of Felton, 1765.

Female and Worker.—Head mostly reddish brown (Ridgway's burnt sienna); blotches behind the ocelli, narrow occipital and hind margins of cheeks, middle of flagellum (from the middle of the third antennal segment to the base of the eighth), black; narrow apical margin of clypeus and apical teeth of mandibles, brownish black. Thorax and legs mainly black, without reddish markings. Abdomen mostly reddish brown; basal two-thirds of first tergite and extreme base of second segment black. The following areas are yellow (Ridgway's light cadmium): narrow preapical portion of clypeus; a broad band on the vertex (behind the ocelli), continued over the upper two-thirds of the cheeks (along the outer orbits); most of the mandibles; narrow anterior and posterior margins of pronotum; tegulae; anterior half of scutellum and postscutellum; apical valvules of propodeum; middle and hind coxal processes; a spot on the upper plate of the mesepisternum (beneath the base of the fore wing); all the tarsi; all the front and middle tibiae; basal half of hind tibiae; broad apices of all femora; and apical fasciae of moderate and somewhat variable width on the first three, four or five tergites and on the second or second and third sternites. Wings, stigma and veins bright ferruginous yellow.

St. Kitts (or St. Christopher). Several female or worker paratypes, without more definite locality (N. Y. Ac. Sci.) (H. A. Ballou.—B. M.). Basseterre, one female holotype and several female or worker paratypes, March 26, 1927 (Corn. Univ.).—Nevis. One worker paratype (H. A. Ballou).—St. Croix. Christiansted, several female or worker paratypes, April, May and June (N. Y. Ac. Sci.). Fredericksted, several female and worker paratypes, March 25, 1927 (Corn. Univ.).

Polistes bahamensis, new species.

A medium-sized, slender species, with the abdomen elongate fusiform, much pointed and compressed laterally at apex. Differing from *P. crinitus* (Felton) and *P. minor* Palisot de

Beauvois mainly in the shape of the head of the female and in the clypeus of the male.

Length (h. + th. + t. 1 + 2): ♀ and ☿, 10 to 13 mm.; ♂, 11 to 13 mm.

Female and Worker.—Head larger than usual; seen from above, transverse, about twice as wide as long, moderately swollen behind the eyes, the cheeks about as bulging as and a little shorter than the upper part of the eye; in front view, distinctly wider than high. Vertex and cheeks separated from the occiput by a fine carina which does not reach the base of the mandibles; lower third of cheeks separated from the gula only by a bluntly rounded edge. Cheeks, in profile, very wide, distinctly widest at the lower third, where they are about as wide as the eye. Oculo-malar space moderately long, in front view nearly one-sixth of the length of the eye. Inner orbits about as far apart on the vertex as at the clypeus. Ocelli in an equilateral triangle; the posterior pair a little closer to the occipital margin than to the eyes, about twice as far from the eyes as from each other. Interocellar area slightly raised transversely behind the anterior ocellus. Antennae slightly less than twice as far from the eyes as from each other; frons between them not carinate, but raised into a low, broad tubercle. Clypeus cordiform in outline, moderately and uniformly convex throughout, distinctly wider than high; upper lateral margins contiguous to the eyes for a distance about equal to the length of the oculo-malar space; lower lateral margins converging to form a very obtuse angle at the bluntly rounded apex; lower, subocular portion of the clypeus about as long as the upper, interocular part. Eyes bare. Antenna rather slender, exactly as in *P. crinitus*. Thorax, abdomen, and legs as in *P. crinitus*.

Sculpture as in *P. crinitus*.

Male.—Structurally like the female and worker, except for the following points. Cheeks much shorter and less bulging on the head seen from above, much narrower in profile (about half as wide as the eye), although distinctly wider than in the male of *P. crinitus*. Eyes as bulging as in the male of *P. crinitus*. Oculo-malar space not much shorter than in the female. Interantennal tubercle very protuberant. Inner orbits about one and one-sixth times as far apart on the vertex as at the clypeus. Clypeus not flattened but very slightly and uniformly convex, without longitudinal depressions, pentagonal or subcordate in outline, slightly wider than high; its upper lateral margins contiguous to the eyes for about one-fourth of the length of the clypeus (less than the length of the oculo-malar space); its anterior margin distinctly projecting, although evenly rounded off; its lower, subocular portion about as long as the upper, interocular part (in general shape the clypeus is much more like that of the female than is the case in *P. crinitus* and *P. minor*). Antenna much as in *P. crinitus*, but the median segments of the flagellum rather thickened; thirteenth segment one and one-half times as long as the twelfth. Seventh sternite as in *P. minor*, without median tubercle, deeply grooved in the middle, with a depressed

apical area, the strongly raised lateral slopes projecting on the sides in profile. Genitalia more like those of *P. minor*, with an elongate elliptical spoon at the apex of the penis. Clypeus and mandibles with few, very scattered, large punctures.

P. bahamensis occurs in the Bahamas in several color phases. We have seen three of these, each of them known from one of the islands only. We are giving them distinct names mainly in order to call attention to this peculiar geographical segregation. It will be extremely interesting to follow further investigations of the wasp faunae of the many other islands that form the Bahama group. The three color phases known to us may be separated as follows:

1. Head and thorax black and ferruginous, marked with yellow; mesonotum entirely ferruginous, usually without yellow lines (rarely with traces). Abdomen ferruginous red, with black base; as a rule only the first tergite with a broad, yellow fascia; rarely the second also very narrowly yellow at apex.....typical *bahamensis* Bequaert and Salt.
   Head and thorax mostly black, with a few ferruginous blotches and numerous yellow markings; mesonotum with two longitudinal, yellow lines or stripes. Abdomen ferruginous red with black base; all the segments with apical, yellow fasciae.....2.
2. Yellow markings of moderate extent; mesonotum and propodeum with two narrow, short lines; face partly reddish brown; apical fasciae of abdominal segments narrow.....var. *bilineolatus* Bequaert and Salt.
   Yellow markings very extensive; mesonotum with four wide, longitudinal stripes; propodeum very extensively yellow; face almost wholly yellow; apical fasciae of abdominal segments broad.
   var. *picturatus* Bequaert and Salt.

Polistes bahamensis, typical form.

Female and Worker.—Head mostly reddish brown (Ridgway's burnt sienna); occiput, blotches about the ocelli, upper side of scape and middle of flagellum above, brownish black to black. Thorax and legs mainly black; upper side of pronotum, most of mesonotum, and posterior half of scutellum, ferruginous red (Ridgway's Sanford's brown); tibial spurs ferruginous brown. Abdomen bright ferruginous red (Ridgway's Sanford's brown); basal half of first segment and extreme base of second, brownish black to black. Pale yellow markings of moderate extent (nearest to Ridgway's light cadmium), as follows: clypeus (except for a median rufous spot); broad inner orbits, filling the whole ocular sinuses and extending very narrowly above them; nearly the whole cheeks and oculo-malar spaces, extending over the vertex where they are very narrowly divided in the middle; most of mandible; tip of antenna (more orange); narrow front margin and very narrow hind margin of pronotum; sometimes traces of two very narrow, median lines on mesonotum; tegulae; anterior half of scutellum and postscutellum; a large spot on upper plate of mesepisternum; two fairly broad longitudinal lines on the middle of propodeum (on either side of the groove); lateral valvules of abdominal articulation; sometimes a small spot on each side of propodeum and on middle and hind coxal

processes; all tarsi; front tibiae; most of middle tibiae (black above in the apical half); basal third of hind tibiae; broad apices of all femora; a medium-sized apical fascia on first abdominal tergite; and sometimes a very narrow apical fascia on second tergite and at the sides of second sternite. Wings strongly suffused with amber to golden yellow, rufous along the costal margin and in the stigma of the fore wings; radial cell more or less purplish; veins rufous.

Male.—Coloration very similar to that of the female and worker, but the yellow markings somewhat more extensive: lower two-thirds of the face yellow; under side of the scape yellow; flagellum more orange than ferruginous on the under side; yellow spots on the under side of middle coxae and the under side of front coxae, as well as prosternum, mostly of that color; under side of front femora extensively yellow, suffused with rufous.

BAHAMAS. Mangrove Cay, Andros Island, female holotype and thirteen female paratypes, May and June, 1904 (W. M. Wheeler.—A. M. N. H.); male allotype, ten male paratypes and thirty-four female paratypes, August, 1904 (Allen, Barbour and Bryant.—M. C. Z.); four female paratypes, June 24, 1924 (C. E. Olsen).

Polistes bahamensis var. **bilineolatus,** new variety.

Female and Worker.—Head mostly reddish brown (Ridgway's burnt sienna); most of vertex, occiput, broad occipital margins, upper side of scape, and middle of flagellum above, black. Thorax and legs mainly black; an obscure spot on each side of pronotum and two longitudinal blotches on mesonotum, rufous; sometimes postscutellum and propodeum partly rufous; tibial spurs ferruginous brown. Abdomen bright ferruginous red (nearest to Ridgway's Sanford's brown); as a rule only basal half of first segment black; sometimes also extreme base of second segment dark brown to black. Pale markings very numerous, varying from bright yellow (Ridgway's light cadmium) to a more creamy color (Ridgway's pinard yellow), as follows: two lateral stripes over the clypeus or most of the clypeus except for a median spot; very wide inner orbits, filling the whole ocular sinuses but not extending above them; most of the cheeks, including the oculo-malar spaces and narrowly extending across the vertex where they are divided by a black spot; most of the mandibles; narrow front and hind margins of pronotum; tegulae; two longitudinal lines over mesonotum, placed in the rufous blotches and rather variable in size and extent; two transverse spots on anterior half of scutellum, sometimes connected in the middle; a narrow, transverse band on anterior half of postscutellum, rarely interrupted in the middle; a large spot on upper plate of mesepisternum; two narrow, longitudinal lines on middle of propodeum (on either side of the groove); lateral valvules of abdominal articulation; sometimes a small spot on each side of propodeum and on middle and hind coxal processes; all tarsi; most of front tibiae (often more or less rufous); basal third or

fourth of middle and hind tibiae, the yellow extending to the apex on the under side of the middle tibiae; broad apices of all femora; regular, medium-sized fasciae at apical margins of first to fifth abdominal tergites (continuing along the sides of the anterior tergites) and of second to fifth sternites; a small spot on each side of sixth tergite; and a large blotch on sixth sternite. Wings strongly suffused with amber to golden yellow, rufous along the costal margin and in the stigma of the fore wings.

BAHAMAS. New Providence Island, female holotype and thirteen female paratypes, November, 1912 (A. M. N. H.); four female paratypes (M. C. Z.); three female paratypes, December, 1912 (U. S. N. M.). Nassau, New Providence, two female paratypes (W. M. Wheeler.—A. M. N. H.); one female paratype, February, 1915 (H. G. Dyar.—U. S. N. M.). Blue Hills, Nassau, New Providence, seven female paratypes, January, 1909 (W. W. Worthington.—C. M.).

Polistes bahamensis var. **picturatus,** new variety.

Female and Worker.—Head mostly yellow (Ridgway's light cadmium); vertex black across the ocelli; occiput black; interantennal area down to the clypeus ferruginous red; antenna mostly ferruginous, the apex more orange, the upper side of the scape and of the median segments of the flagellum blackish. Thorax and legs mainly black; a spot on each side of pronotum and extensive areas of mesonotum ferruginous red; tibial spurs ferruginous brown. Abdomen mostly bright ferruginous red (Ridgway's Sanford's brown); basal half of first segment and extreme base of second brownish black to black. The yellow (Ridgway's light cadmium) markings of thorax, legs and abdomen are very extensive as follows: broad front and hind margins of pronotum, their connections forming large, triangular spots in the anterior half; four broad, longitudinal stripes on mesonotum, the two median ones not reaching the front and hind margins, the two lateral ones much shorter and placed close to the tegulae; tegulae; more than the anterior half of scutellum and postscutellum; a large spot on the upper plate and a much smaller one on the lower plate of mesepisternum; most of propodeum, leaving the median groove black and a black spot on each side behind the postscutellum; valvules of articulation of abdomen; minute spots on middle and hind coxal processes; all tarsi; front and middle tibiae; basal half of hind tibiae; broad apices of all femora; large spots on under side of front coxae; and broad apical fasciae on all abdominal tergites (more or less continued along the sides; that of the first abruptly emarginate by a rectangular, rufous, median spot) and on second to sixth sternites. Wings as in the typical form.

BAHAMAS. Gold Rock, Acklin Island, female holotype, March 6, 1909 (W. W. Worthington.—C. M.).

THE NEUROPTERA OF HAITI, WEST INDIES.[1]

ROGER C. SMITH,
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An excellent opportunity to collect and study the Neuroptera of Haiti came to the writer while he was in the employ of the Service Technique between July 15, 1928 and March 20, 1930. While this work was not a major enterprise, nevertheless a fair representation of this order has been brought together. Some of the insects, notably the Chrysopidæ and several Myrmeleontids[2], were found to be common insects there.

There are no published papers dealing with the Neuroptera of either Haiti or Santo Domingo but several species from Hispaniola, belonging in this order, have been described in taxonomic papers. Navas, who is a prolific writer on Neuroptera, has published papers containing many genera and species from the neighboring countries particularly from Cuba, Central America, and South America. Not all of these papers were available to the writer, but Professor Nathan Banks very kindly determined the species which are included in this paper. The writer was privileged to study the Neuroptera collections in the Museum of Comparative Zoology at Cambridge, Massachusetts during the summer of 1927[3]. The emphasis, while there, was placed on the Chrysopidæ, but the collection of Neuroptera from tropical America was also studied.

Representatives of all of the species of this collection of Haitian Neuroptera and the types of new species upon which this paper is based have been sent to Professor Nathan Banks for checking up and criticism of the writer's determinations and for final deposition in the Museum of Comparative Zoology, Cambridge, Massachusetts. The writer alone is to be held responsible for any mistaken identifications of this material or synonyms which may be discovered later. Sincere thanks and

[1]Contribution No. 387, from the Department of Entomology, Kansas State Agricultural College.

[2]The spelling of family names as in Tillyard, Insects of Australia and New Zealand, 1926, is being used.

[3]Acknowledgment is made to Bache grant No. 286 for carrying on this study of types. Some of the illustrations for this paper were made with this grant.

acknowledgment is expressed to Professor Banks for this and much past aid. Some paratypes or duplicates have been sent to the Department of Entomology, Service Technique, Port au Prince, Haiti, and some have been retained by the writer.

General Topographic Features of Haiti.

A brief summary of the geography and climate of Haiti was given by Smith and Audant (1930). The greater part of these specimens came from the region around the Agricultural college at Damien which is located on the Cul de Sac plain five miles northeast of Port au Prince and about a mile from the sea. This area is a broad level plain bounded on the north and south by mountains 1000 to 3500 feet high and extending east to the salt lakes. There are sugar cane and cotton fields in the western parts around the college and where irrigation water is available but elsewhere the land is grown up with mesquite, cactus and masses of tropical vegetation, making it impenetrable except along trails and roads.

There is a sisal and cotton experimental farm of about 400 acres at Hatte Lathan about 3 miles farther northwest from the college along the road to St. Marc where some of the specimens were collected. Other specimens were collected at electric lights on porches in Port au Prince and at Petionville, which is a small village about 2 miles east of Port au Prince on the side of a mountain at an altitude of about 1500 feet. Other specimens came from Kenscoff about 7 miles still further up on the mountain and at an altitude of about 3000 to 3500 feet.

Cotton, citrus trees, several gaiac (guyac) trees, mango trees, rose bushes, and sorghums yielded Chrysopid larvæ and adults in fair numbers. The best collecting period extends from about October to March.

List of Known Species of Neuroptera from Haiti by Families.

No representatives of the Sialidæ, Raphidiidæ, Mantispidæ nor of the lesser families of Hemerobiids were collected during this period. No representatives of these groups have been reported, to the writer's knowledge, for Haiti or Santo Domingo.

Hemerobiidæ.

The Hemerobiids are rare in Haiti, only three specimens having been brought back.

Nusalala damiensis n. sp.

A small slender species without prominent markings but which can be identified by the blackish-brown line along the outer gradates of both wings nearly parallel with the wing margin and the swollen flattened second and third tibiæ.

Head brownish-black; front and clypeus naked, but vertex and occiput sparsely covered with conspicuous brown setae. Antennae uniformly light brownish, thickly covered with short brown setae, reaches to about the middle of the folded wings; basal segment marked with black. Palpi uniformly amber.

Body dark shining brown, sparsely covered with short gray pile. Prothorax sparsely beset with brown setae with gray tips.

Front wings as indicated in Pl. II, Fig. 12, with 3 series of gradate veinlets, outer series of 7, middle series of 2 (to M) and an inner series of 4. Most of veinlets with light portion in middle, outer series dark brownish forming a conspicuous dark brown line parallel with the margin of the wing. Five radial sectors. Recurrent vein forked with an anterior branch to the margin. A conspicuous black spot on Cu just basad of the fork of Cu.

Hind wings with 2 series of gradates, an outer conspicuously dark brown one, parallel to the margin of 6 veinlets and inner one of 4 (to M); the lower veinlet lighter in color; 4 radial branches.

Legs uniformly light amber, sparsely beset with light brown setae. Front tibiae only slightly swollen beyond the middle, but middle and hind tibiae are markedly swollen and flattened, and the hind tibiae are slightly curved.

Described from a single specimen, a female, collected on cotton by André Audant, May 12, 1929. Total length 9 mm. Length of front wings, 8 mm. Width of front wing, 3.5 mm. Length of hind wing, 7 mm. Width of hind wing, 3 mm.

Type in Museum of Comparative Zoology.

Micromus haitiensis n. sp.

A slender winged species with light wing and body coloration and without conspicuous dark spotting.

Face elongate, light brownish, marked with darker brown areas and with two triangular ocherous areas below the antennae. Four pairs of long gray setae on the clypeus, two pairs at the upper margin and two

pairs on the lower. Palpi uniformly light brownish, very sparsely set with colorless setae. Mandibles shining black, antennae light amber closely beset with light brownish setae, vertex and occiput yellowish-brown, carinate, sparsely beset with short gray setae.

Body brown, covered with gray pile. Prothorax light brown, marked with dark brown, sparsely beset with gray setae. Legs entirely amber, sparsely covered with light brownish setae. Femora approximately equal in diameter throughout, no prominent expansions. Abdomen light brownish, bearing prominent brown setae with gray tips on the distal and ventral portions.

Wings as illustrated in Pl. II, Fig. 10. Front wings without recurrent vein; with 2 series of gradates, an inner and outer series of 4 (to Media) veinlets each. The first three of outer series are dark brown, fourth lighter brown, distad of others. Four sectoral branches. Hind wings with 2 somewhat irregular gradate series of 2 (or 3) and 3 each, without prominent markings. Costal wing area very narrow before the stigma.

Front wing, 7 by 2.5 mm. Head to tip of wings, 7.5 mm.

Type, a female, collected at lights in Petionville, near Port au Prince, by Dr. H. L. Dozier, February 17, 1930. In Museum of Comparative Zoology.

A paratype collected on cotton by André Audant, February 9, 1929 in which the darker brown areas are reddish brown, otherwise like the type.

Megalomus lioni Navas.

This has been described from Port au Prince, Haiti. (Navas: Insectos del Museo de Paris 4ª Serie. Broteria, 1927, Vol. 24, Fasc 1, p. 26–27). No representatives of this species have been seen by the writer.

CHRYSOPIDÆ.

Haiti has a relatively large number of species of Chrysopidæ. They are at times fairly plentiful in cotton fields and on certain trees when infested with aphids, mealy bugs or white flies.

KEY TO THE GENERA OF HAITIAN CHRYSOPIDAE.

A. Median loop of front wings (M3 plus 4) extending in a gentle curve, enclosing an elongate oval cell, (Fig. 11)..... **Chrysopa** Leach

AA. Median loop angulate, enclosing a larger, angulate cell, (Fig. 20), **Leucochrysa** Banks

KEY TO THE SPECIES OF CHRYSOPA OF HAITI.

A. Basal segment of antenna with one or two brownish-red or red longitudinal bands on the upper side, only rarely much faded.
  B. Basal third or fourth of antennae beyond segment one, is black..**haitiensis**
BB. Basal portion of antennae not black but uniformly yellowish or covered with small brownish setae.
  C. A definite reddish line each side of pronotum. No brown spots on the mesoscutum, inner series of gradates of only one to three reddish-brown veins.....**damiensis**
  CC. No definite reddish line on each side of the pronotum; but sides are lightly suffused with reddish; a prominent purplish spot or diffused brown on each mesoscutal lobe, inner series of gradates of about four black veins.....**freemani**
AA. No red longitudinal bands on basal segments of antennae.
  B. Pronotum with a definite red or reddish band along each lateral margin.....**antillana**
  BB. Pronotum without definite red bands along each lateral margin, but a faint reddish suffusion may occur which is indefinite as to outline.
    C. Genae without a prominent, definite red band from eye to mouth.
      D. Meso- and metanotum yellowish red on the sides, palpi yellowish brown, last segment elongate, dark.....**lioni**[3]
      DD. No reddish or brownish markings on sides of the thorax, last segment of palpi not especially elongate, brownish or blackish; no black line on segments.
        E. A green, generally robust, species with pronounced ivory dorsal band on body, face with some suffusion of reddish, basal cross vein of inner series parallel or almost parallel to rest....**thoracica**
        EE. A very pallid or yellowish species, face wholly yellow and in some pinned specimens, entire head is brown or reddish brown; no dorsal median ivory stripe on thorax, inner series of gradate veinlets usually only two or three brown veins, the basal one not parallel to the others.....**wolcotti**
    CC. Genæ with a definite band from the eyes to the mouth of some shade of red, or the reddish may be indefinite if there is a pair of red comma-shaped spots on the vertex.
      D. Gradates and many other cross veins dark brown or black; palpi with a narrow brown or black line on outside. No reddish suffusion on sides of pronotum.
        E. A pair of definite red marks on the vertex in the form of commas or parentheses, less commonly a reddish suffusion on the vertex. Gradates and most other veins wholly or in part black.....**dozieri**
        EE. No reddish comma or V-shaped marks on the vertex and the red spots next to the compound eyes are either absent or greatly reduced. A yellowish or very light median dorsal band.....**estradai**
      DD. Wings with all veins entirely green or only a few cross veins brownish green; at least with not very dark venation. Palpi with a broad black or dark brown line outside so that segments appear brownish or dark. Sides of pronotum suffused with reddish.....**exterior**

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[3]This species has not been seen by the writer.

Chrysopa damiensis n. sp.

A small, very common species in the lowlands of Haiti recognized by absence of genal spots, single longitudinal reddish band on the upper side of the basal segments of the antennæ, by the broad reddish band along the margins of the pronotum and by the dark brown cross veins in the wings, the front wings in particular.

Vertex yellowish green, without marks; front ivory; clypeus and labrum brownish, genae without bands, palpi broadly banded with brown, end segments nearly wholly brown. Basal segment of antenna with a broad, red band on upper side, most distinct on distal part of segment, fading basally; second segment somewhat reddish at end of red band; remainder of antennae pale yellowish except end segments, which are somewhat brownish. Antenna reaches nearly to the tip of the wings.

Pronotum with a broad, faded, salmon red longitudinal band along each lateral border, the band arising between the vertex and the anterior pronotal angles and broadening to the transverse suture, beyond which the band is narrower and less distinct. Sides of pronotum sparsely beset with fairly conspicuous colorless hair. Rest of thorax and abdomen pale yellowish green (in death). Sides and tip of abdomen with colorless hair as on the thorax.

Front wings (Figure 11) with practically all cross veins nearly or completely brown, the venation is therefore conspicuously dark; stigmas obscure, slightly greenish. Two series of gradates, 5 (outer) 2 and 3 inner, the veinlets light at ends, brown in the middle. Hind wings with less brown venation, gradate series 4 and 1, veins light brown except at ends. Venation as shown in Figure 11. Apices of wings angular.

Venter of body lighter yellowish-green than the dorsum. Legs very pale, thinly covered with short black setae.

Type, a male, reared by the writer from a larva collected at Hatte Lathan, Haiti, January 18, 1929. Total length 12 mm., length, front wings, 9.5 mm., width, 3.5 mm. In Museum of Comparative Zoology.

There is the usual range of variations in the series of about 50 paratypes.

The total length varies from 10 to 14.5 mm. The reddish borders of the pronotum vary from broad dark red bands to short, faint salmon bands. In some specimens there is a narrow green border between the bands and the extreme outer border of the pronotum. The antennal bands are generally red but they vary particularly in length. The venation of the front wings is not always as dark as the type. There is

some variation in the number of the gradate veinlets. The front wing series varies from 4–1 in the small specimens to 6–3 in the larger ones. In the hind wings the range is from 4–1 in small specimens to 6–3 in the larger ones.

This is the most abundant species of Chrysopid on the lowlands around Port au Prince. It occurs on cotton primarily being most plentiful from December to May but is present all year. It is similar to *C. villosula* Navas of Cuba but according to Banks, that species has two stripes on the basal segments of the antennæ.

The species name refers to Damien where the headquarters of the Service Technique and the Entomological Department are now located

Life History and Stages.—The eggs are deposited singly and stalked, and are light yellowish-green in color. They hatch in 4 days; 1st. instar 2 or 3 days; 2nd. instar 3 to 5 days; 3rd. instar 3 to 6 days. Larval life, average of 5 cases, 11.3 days. Pupal stage 14 to 22 days.

The larva is a trash carrier (Fig. 1), and therefore has the body contour, long stalked thoracic tubercles and small microscopic hooked setæ on the dorsum of the abdomen which is characteristic of trash carriers. General color of the body is gray, marked with brownish-black. Head with two pairs of black marks, the median pair connected posteriorly forming a loop. Body darker than most trash carriers and with more black marks along the segments and the dorsal vessel than is usual.

In addtion to cotton, it has also been taken on papaya, artichoke, "pois maldioc" and cow peas. It was reared by feeding on cotton and feterita aphids and on the black aleyrodid on citrus.

Chrysopa exterior Navas.

NAVAS: Ann. Soc. Scient. Bruxelles, 1922, p. 170. (externa).
NAVAS: Mem. R. Acad. Cienc. Barcelona, 19, No. 5, 1925, p. 12. (exterior).

Similar to *C. harrisii* of the U. S., to *dozeri* of Haiti and *estradai* Navas of Cuba. The identity of these specimens was determined by Professor Banks. It may be recognized by the sides of pronotum being darker green, generally suffused with red, no dorsal yellow or ivory band and genæ not suffused with red but with a clean cut red band.

Inasmuch as the original descriptions of the Neuroptera species of Navas included herewith are very brief and have been published in journals not available to most American workers, it has been thought advisable to include somewhat detailed re-descriptions of those species in this paper.

Head light yellowish, almost without any greenish tinge. A definite red band from eye to mouth on the genae. Palpi brownish with last segments distinctly brown. Antennae long, reaching nearly to tips of wings. Basal segment yellowish without markings or setae. Remaining segments appear brownish because of the short brown setae, but the ground color is light yellow. Vertex light yellow, a pair of red spots next to the compound eyes.

Pronotum yellow, but without definite median yellowish band, covered sparsely with gray setae; margins darker green, with a reddish tinge particularly at the anterior angles. This marking is specific. Rest of body yellowish and without markings.

Abdomen with gray setae on the lower part. Legs light yellowish, sparsely beset with short brown setae.

Wings with all veins yellowish green, median loop fuses well before the cross vein in front wing. An outer series of gradates of 7 green veins and an inner series of 5, the outer series less than twice the length of the middle veins from the margin; the inner series near the middle of the sectoral area. Outer series in hind wings of 6 veins and inner series of 5. Stigmas not apparent. Tips of wings sharply angulate. Total length, 14 mm., length of front wing, 11 mm., width, 4 mm.

A large series of specimens collected around Damien, October to April, on sorghum, feterita and cotton. Many of the adults were reared. Specimens differ in the amount of green and yellow on the body some appearing distinctly light greenish. The pronotal lateral markings in some specimens are more distinctly reddish. This marking is lateral and not suggestive of the bands which occur in ***haitiensis***. Some specimens show a few dark veins in the anal region of the wings. Banks informed the writer of the identity of this species and pointed out that Navas had originally described this species as *externa* but this name having been used by Hagen (1861) and according to Navas, by Petersen for a species from Australia, Navas indicated (1925) the name *exterior* for the Species.

Typical Life Histories.—Eggs December 19; hatched December 23; spun January 5; emerged January 16. Eggs February 23; hatched February 26; spun March 8, emerged March 21. Larva of the type of *C. plorabunda;* (Fig. 2), not a trash carrier. Head yellowish with two black longitudinal bands and with a short narrow single median one. This is a distinct recognition

character. Median portion of body reddish brown, with light yellowish border. Tubercles all yellow, bearing white setæ. Legs smoky.

Chrysopa haitiensis n. sp.

This species differs from *C. lateralis* of Florida in that the dark red or maroon band on the basal segment of the antenna of the Haitian specimen is narrower, of more nearly uniform width, darker red in color and is located more nearly in the middle of the upper side of the segment instead of at the outer margin; the genitalia in the type are tinged with brown; the pronotum is broader than in Florida specimens and slightly longer and the general body color is a little darker green. The species is also similar to *C. epheba* Navas according to Banks.

Head uniformly yellowish, no genal nor vertical marks. Palpi uniformly light brownish. Basal fourth of antennae blackish, lighter beyond; basal segment of antenna with dark red band on upper side as described above.

Pronotum about as broad as long, sides parallel, without lighter median band, sides of pronotum red, the red beginning at the extreme lateral margins. Rest of thorax yellowish green. Abdomen darker green on dorsum with yellowish-green sides and venter. Tips of genitalic processes dark brown. Genitalia open, the upper and lower plates appearing in side view like the mandibles of some reptiles. Legs uniformly yellowish green, tarsi light brownish.

Wings with longitudinal veins green. Outer series of gradates in front wings of 6 veinlets, brown in middle, inner series of 3, also brown in middle; inner series close to outer, being only about twice their length apart, basal veinlet of inner series not parallel to the others. First 9 cross veins between R and Rs brown in middle, the one based being darkest brown and the rest becoming progressively lighter in color. Cross veins between pseudo-media and cubitus brown in middle, anal and cubital branches at margin brown except at ends. Median loop ends beyond the cross vein, enclosing a very narrow elongate cell. Hind wings with two series of gradates, 7 and 2, close to each other. All cross veins appear green or a few with only tinges of brown near the middle. Stigmas yellowish green, fairly prominent.

Length of head to tip of folded wings, 15 mm., width of front wing, 4 mm.

Type, a male, reared from a larva collected on a citrus tree at Petionville, December 22, 1928.

The seven paratypes show a variation in the shape of the pronotum, some specimens having a longer, narrower pronotum than the type. Some specimens have the gradates and other

cross veins in the basal part of the wings dark reddish brown except for short light areas at the ends. Collected by beating a gaiac tree at Hatte Lathan, in January and February.

Larva a trash carrier, superficially resembling the larva of *C. lateralis*. Only one was seen. It had two pairs of converging, brown dorsal bands on the head, tips of tarsi black.

Chrysopa thoracica Walker.

WALKER: Catalogue Specimens Neuroptera, Brit. Mus., 1852, p. 243. St. Domingo.

One of the larger and more robust species of *Chrysopa* in Haiti identified by Banks. A fine series of 31 specimens taken most of which faded badly. Recognizable by the dark green body coloration, broad short pronotum with yellow dorsal band, yellowish antennæ and nearly wholly green venation.

Head yellow, clypeus heavily suffused with red, forming a fairly definite red bar, though this may be a secondary feature. A narrow somewhat indefinite reddish bar under each antenna on the front. No red marks on the genae. Vertex with two somewhat indefinitely outlined red spots forming an indefinite V pattern. Palpi uniformly light reddish brown. Antennae wholly yellowish, without any markings, reaching to near the tip of the folded wings. Body with narrow, ivory or yellowish dorsal band, most definite over the thorax and a little less definite over the abdomen. Prothorax nearly as broad as the head, including the compound eyes, making this region unusually broad. Body with a narrow ivory median band and blackish-green borders.

Wings fairly broad and somewhat angular. Front wings with two series of gradates, 8 and 4 veinlets; gradates and at least part of most other cross veins in the basal half of the wing blackish. Fusion on M^{3+4} well beyond the cross vein. Hind wings with two series of gradates 6 and 4, only slightly brown. Stigmas yellowish, obscure. Legs uniformly yellowish, tarsi light brownish.

Length, 16 mm. Length of front wings, 13 mm.; width, 5 mm.

Specimens vary greatly in the amount of red present and in the general body coloration. The reddish suffusion on the vertex forming a broad indefinite V is fairly constant but the red on the clypeus and front is entirely absent on some specimens. It is probably secondary. The dark green coloration of the body is nearly gone in some specimens but the narrow lighter ivory or light yellow dorsal band is constant. Some specimens have more brown in the wings than occurs in the type.

A tree species collected July to March at Hatte Lathan and Damien by beating trees and bushes. Several specimens

were reared. Egg deposited February 1; hatched February 5; spun February 15; adult February 26. Larva is of the trash carrier type. One larva taken on bamboo and reared to adult. The adult was a little under size, length 13 mm.

Chrysopa dozieri n. sp.

A small green, non-trash carrying species readily recognized by the two comma shaped red spots on the vertex, sometimes forming a loop, by the red suffusion on the clypeus and the dark sectoral veins. Banks says this species is close to *torrei* Navas but the latter species has red on sides of thorax and the palpi are very black.

Head light yellowish green. A bright red suffusion under each eye and extending along the fronto-clypeal suture, not in the form of a definite red genal band as occurs in *C. plorabunda*, for example. Palpi with narrow black or brown longitudinal band on outside of segments. Vertex yellow with a pair of bright red marks resembling parentheses faintly connected below. Rest of head yellowish green. Antennae wholly yellowish, last segment black, reaches to the tips of folded wings. Body with a dorsal ivory median band bordered by yellowish-green areas. Lateral border of pronotum darker green, brightly marked with blackish brown. Rest of body yellowish green, ivory band extends entire length, especially prominent over the thorax. Fore wings with gradates blackish, also sectoral, medial and cubital cross veins blackish at the ends in basal half of front wings. Wings are narrow and somewhat angular at the tip. M_{3+4} fuses at the cross vein. Gradates 6 (outer) and 5, entirely brown. Stigmas unmarked. Hind wings with 7 gradates (outer), 4 in inner. Basal 3 marked with blackish. Legs wholly yellowish green.

Total length is 13 mm. Length of front wing, 10 mm.; width, 3 mm.

Specimens collected primarily on cotton but also by beating trees and bushes in December to February. Localities at Damien, Hatte Lathan and Gonaives, Haiti.

Specimens differ as to the amount of red on the clypeus, on the vertex and as to size. In some, the red dots on the vertex are very faint and rarely they are rather diffuse. Paratypes measure up to 14 mm. long. Dorsal ivory band is less distinct on some specimens.

About a dozen were reared from larvæ to adult. The larvæ resemble those of *Chrysopa rufilabris* of the U. S. except that the reddish markings are lighter and less extensive, especially in the metathoracic region. The two longitudinal

head bands are the same. Body with 2 irregular dorso-lateral maroon bands from head to tail. Border, including tubercles, is yellowish. The cocoons are spun on leaves.

Named in honor of Dr. H. L. Dozier who was Entomologist on the staff of the Service Technique, in Haiti, from 1929 to 1931.

Type in Museum of Comparative Zoology.

Chrysopa estradai Navas.

NAVAS: Rev. R. Acad. 1924, 21, p. 334.

Resembles *dozieri* and *exterior* of Haiti and *C. rufilabris* of the U. S. but there are more dark cross veins than in the latter and there is a definite median ivory band. This species may be recognized by the absence of red on the vertex and the definite red bands from eyes to mouth.

Face light yellow with broad light red band from eyes to the mouth; no other markings. Both palpi with black longitudinal line on outside of segments. Vertex of head with slight indefinite reddish marks. Antennae wholly yellowish, unmarked except distal segments light brownish; reach to tips of folded wings.

A yellowish median ivory band extending the length of the body; somewhat indefinite at the start but prominent over the mesothorax and anterior part of the abdomen; borders of pronotum are darker green with faint maroon markings at anterior angles. Rest of body yellowish green.

Front wings narrow, with gradates entirely black. Outer series of 5 about twice their length from the margin of the wing. Inner series of 4 veinlets about midway in the sectoral area. Costal, sectoral, radial and medial cross veins in the basal half of the wings black at the ends. Median loop fuses before the cross vein. Hind wings with gradates 3, (inner) and 5 (outer), blackish. Stigmas greenish, indistinct. Legs entirely yellowish green.

Total length, 10 mm. Length of front wing is 9 mm., width is 3.5 mm.

Other specimens show absence of reddish blotching on vertex. Gradates outer, 5 to 7; inner 5 to 6. Four specimens collected December to February, by beating trees and cotton which is grown on tree-like bushes in Haiti. Three specimens collected on cotton December and February inclusive.

Chrysopa antillana Navas.

Banks says that no formal description of this species was published by Navas but that it was included in a synoptic table in 1924. The name is therefore valid.

This species is readily recognized by the unusually long neck with a pair of bright red dorso-lateral bands and the inner series of gradates is located exceptionally basad.

Head yellow throughout. Face elongate, somewhat triangular. A broad, bright red band from eyes to mouth over the genae. No suffusion of red on clypeus. Palpi yellowish with black line on outside of the segments. Antennae yellow (broken off), vertex yellow, unmarked.

Pronotum very long and slender, fully twice as long as broad; yellow without median band, but with a pair of bright red dorso-lateral lines extending from the anterior angles to the last transverse, pronotal suture, stopping short of the mesonotum; the red bands are more than their width from the lateral margins. The remainder of body light yellow with darker yellow band each side of abdomen. Venter yellowish gray. Legs uniformly yellowish.

Front wings with an outer series of 7 (6 in other wing) gradates and an inner series of 3, wholly reddish brown. Inner series far basad, about twice their length from the radial sector. Cross veins in the basal half of wings black at ends or in entirety. The median loop ends beyond the cross vein. Hind wings with an outer series of 5 and an inner series of 2.

Total length, 16 mm. Length of front wing, 13 mm. Width, 5 mm. A single female specimen, without date.

Chrysopa wolcotti n. sp.

A very pallid, small, species characterized by the absence of any decided body markings, the inner series of gradates usually only 2 or 3 brown veins, the lower one not parallel to the others. Resembles *thoracica* but may be distinguished as indicated in the key.

Entire head and antennae yellowish, without any color spots or marks except as a result of fading. Distal segments of palpi entirely black.

No dorsal yellow median band on body. Pronotum yellowish green, without lateral markings. Abdomen darker yellow, or yellowish brown.

Wings very dark; gradates of front wings 5 and 2, wholly black; basal vein of inner series not parallel to the others. Most all other cross veins very dark or black. Median loop fuses just beyond the cross vein. Stigmas obscure. Hind wings with two rows of gradates, 5 and 2. Basal vein of inner series again not parallel to the others.

Total length, 12 mm. Length of front wing, 10 mm., width, 4 mm.

Type, a male, collected at Damien by the writer and deposited in the Museum of Comparative Zoology.

Named in honor of Dr. Geo. N. Wolcott who began the Entomological work of the Service Technique and continued in charge for four years.

Seven specimens collected at Damien. Collection dates were November to February. This species was not reared and the host plants are not known.

While all the specimens have faded, the wings of all are quite dark. Basal gradate of inner series not parallel to others. Gradates in front wings vary 2 to 4 (inner) to 5–7. The inner series usually is of only two brown veins however. The entire head of four specimens is brownish in color. This is believed to be only secondary coloration since the wings are all very close to those of the type. The total length varies from 11 to 15 mm.

Chrysopa freemani n. sp.

Resembles *C. villosula* Navas and *Chrysopa cubana* Hagen but lacks the prothoracic red stripes of latter. This is a small distinct species of Chrysopa, with prominent orange triangular areas behind the antennæ, a red band on the upper side of the basal segment of each antenna, two brown spots on the mesothoracic tergal lobes and very dark wing venation.

Head ochreous in color, no clypeal or genal marks. Maxillary palpi practically entirely black in color, while the labial palpi are amber. Antennae without marks. A triangular area enveloping the antennal sockets extending somewhat below the antennae and to the pronotum above, is pronounced light yellow in color. Antennae unmarked except basal segment has a dark red band on upper side.

Lateral margins of pronotum is suffused with red. Median portion light green. A prominent purplish quadrilateral spot on the front of each mesoscutal lobe. Rest of body yellowish green. No dorsal ivory band. Legs wholly yellowish.

Wing veins largely dark. Gradates, inner series of front wings of 4 and outer series of 6, wholly black. Median loop fuses beyond the cross vein. Stigmas fairly prominent, yellowish green in color. Hind wings fairly dark, with gradates 5 (or 6) and 2; wholly dark reddish brown. Costal, sectoral and other cross veinlets in basal half of wing deep reddish black. Length of front wing, 11 mm.; width, 3.5 mm. Total length, 12.5 mm.

The type, a female, was taken November 16, 1929 at a porch light at an altitude of 500 ft. in Port au Prince. There were some sour orange trees in the yard heavily infested with the black aleyrodid. The species probably has a trash carrying

larva as this type of larva greatly predominated among these aleyrodids. A single paratype, without date, differs only in that the mesoscutal purplish spots are less definite. The whole lobe is streaked with brownish-purple.

The species is named after Dr. George F. Freeman who built the Service Technique and formulated an educational policy for Haiti.

Type in Museum of Comparative Zoology.

Chrysopa lioni Navas.

NAVAS: Bol. Soc. Iber. Cien. Nat. 1927, p. 54.

This species has been described from Port au Prince, Haiti. The following is the writer's translation of the original latin description.

"*Chrysopa lioni* sp. nov.

Yellowish brown. Head with eyes dark coppery. Apex of antennae somewhat dark; palpi yellowish-brown, last segment of labial palpus dark, elongate.

Prothorax transverse, margins parallel, anterior angles obliquely truncate, meso- and metanotum yellowish-red on the sides.

Abdomen yellowish, pilose; venter yellowish.

Legs brownish, with brownish pile, posterior tibiae slender, scarcely compressed.

Wings hyaline, iridescent, venation yellow. Stigmatic pile and border similar in color, with few gradate veinlets. Apex of anterior wings subacute, many veins brown; divisionary cell narrow, elongate, 5 intermediate veinlets, first united basad and near the apex of the divisionary cell, gradates 3–5.

Apex of the posterior wings acute. No veins dark except costals. Gradates 2–5 or 3–5.

Length of body, 6.8 mm. Length of anterior wings, 10.1 mm. Length of posterior wings, 9 mm."

Country, "Haiti, Port au Prince, G. Lion, 1910" Paris Museum."

No specimens conforming to the description of Navas have been seen by the writer.

Leucochrysa haitiensis n. sp.

A fine large species similar to *L. floridana* but with two longitudinal red lines on the upper side of the basal segment of the antennæ, with four pairs of dark spots on the pro- and

mesonotum and with conspicuous brownish stigmas in both pairs of wings.

Face ivory, no markings on palpi nor genae. A small brown spot between and somewhat below the antennae; with a pair of chocolate red longitudinal lines forming a V-pattern on the vertex above the basal segment of each antennae and extending to the compound eye. Antennae with two longitudinal dark red bands on the upper side of each basal segment, and a part of the 2nd segment also.

A chocolate-brownish, narrow band at each side of the pronotum only partly visible on the dorsum. A pair of dark brown dots dorsally near the posterior margin. A pair of chocolate-brown spots on the mesoscutum, another pair on the mesoscutellum and another on the base of each wing at the origin of the anterior veins of the wings. Rest of body and legs without distinguishing marks.

Genitalia, a specialized expanded structure, with a small brown spot on each upper lobe. Both lobes covered with prominent yellowish hair. The small circular areas laterally are unusually large, situated on a hyaline area and sparsely beset with relatively long setae.

Wings with most of cross veins in the posterior half of the wing partly or wholly black (Pl. II, Fig. 20). The anal and cubital branches are particularly dark. Median loop entirely black. Cell within is clearly angulate, fusion of median branch is well beyond the cross vein. Two series of gradates of either 6 or 7 each, about equally spaced; veins nearly or wholly black. Hind wings with two series of gradates, only partly brown, a portion of Rs beginning about two-thirds of distance from origin to beneath the stigma is conspicuously black. Stigmas prominently brownish in both pairs of wings. Sc brown in stigmal area.

A fine, large species 17 mm. from head to tip of wings. Length of front wing, 15 mm.; width, 5.5 mm.

Type, a male, collected Feb. 15, 1929, on papaya by the writer and deposited in the Museum of Comparative Zoology.

Adults collected on feterita, papaya, on artichoke, taken at lights, and reared December to March inclusive. Eggs are white in color, appearing like hatched eggs of common North American species. Larva a trash-carrier with a very dark color pattern (see Pl. II Fig. 5). Head dark brown except for narrow yellowish areas between the spots. Dorsum very brown. Lateral tubercles whitish or yellowish forming a light band each side of the body. Venter very brown. Cocoon entirely covered with trash. Life history: egg stage, 4 or 5 days; larval, 14 to 25 days; pupal, 15 to 25 days.

MYRMELEONTIDÆ.

Haiti has a fairly good population of Myrmeleontids. The larval pits were very plentiful in the late fall and early summer under the eaves of buildings, in the earthen floor garages and in the sand along creeks. A large collection of larvæ was made the latter part of April near the Bassin Générale and at Hatte Lathan June 8, 1929. Some of the adults were reared from larvæ collected in pits in the Cul de Sac region while others were collected at lights. It was interesting to observe the difficulty the larvæ had keeping the pits open on windy days.

Glenurus cerverai Navas.

This fine large species, of which six specimens were collected in Haiti superficially resembles *Dendroleon obsoletum* of the U. S. except as to wing spotting (Fig. 13), and body coloration. It was identified by Banks.

A black band across the face at the antennae, a brown carina extending across the vertex, dark brownish occiput with longitudinal brown bars near median line and a large black spot near each eye. Remainder of head light brownish in color. Palpi yellow; distal segment of labial palpus swollen in middle and blackish at the tip. Antennae with slender cylindrical segments. Each segment is black basally and reddish brown distally. Two basal segments completely black; club of flattened segments, black in color.

Prothorax uniformly grayish or purplish-brown dorso laterally; a light median line and with black areas each side, the black broadens, converging slightly posteriorly. Rest of thorax brownish with mottled areas of darker brown. Abdomen dark brown, each segment whitish along the anterior border. Venter of body very light brownish in color. Legs relatively long and slender, with alternate white and black bars. Sparsely beset with slender white and black bristles. Tibial spurs approximately as long as the first three tarsi, brown and slightly curved.

Wing venation and spotting as indicated in Figure 13. Length of front wings, 32 mm.; width of front wing, 7.5 mm. Total length, 37 mm.

Six specimens from Damien and Port au Prince January to December. One specimen, collected August 1924 by Dr. G. N. Wolcott at Port au Prince, is very much undersize. Length of front wing 22 mm. Total length 28 mm. This specimen may be a variety of *haitiensis*. The wing markings are distributed similar to Figure 13 but the marks are smaller and light brown in color. The head and thoracic markings are the same as described. There is some variation in the spotting chiefly as to the size of the spots. The triangular area in the

middle of the posterior margin of the front wing is entirely fuscous in some wings and clear in others.

Vella fallax subsp. **haitiensis** new subspecies.

RAMBUR, 1842. Hist. Nat. Ins. Neur., p. 385. (*Myrmeleon*).

This fine large form differs from *V. fallax* according to Banks in only a few characters. He says this is not identical with *V. eggerti* Petersen from St. Thomas which has one series of cells between all the branches of the radial sector as this species from Haiti has two series between several branches.

(ESBEN-PETERSEN. Deutsch. Ent. Zeitschr., 1928, p. 74–75. *V. eggerti* n. sp.)

Face is yellow, antenna missing on the type. Labial palpi usually long, yellow. Pronotum about as broad as long; a black narrow Y-shaped, median band with anterior arms of the Y fusing at the head; black converging bands at the side and yellowish-brown dorso-laterally. Rest of thorax predominately brownish-black with some yellowish spots between. Venter of thorax yellowish-brown, rather thickly beset with long hair mostly white in color. Legs yellowish beneath, but largely blackish or brownish above; thickly beset with long white hair. Tibial spurs strongly curved and as long as first three tarsal segments. Tarsi black. Banks states that this specimen differs from typical *fallax* by having only one spine behind on the middle femora instead of two.

Abdomen brownish-black but somewhat indistinctly striped with dark yellow longitudinal dorsal lateral bands.

Venation shown in Figure 16 which, however, does not show the light and dark areas on the veins. Wings have the appearance of being lightly brown and gray barred. Membrane without spots, veins irregularly alternately light and dark spotted. Stigmas yellowish-white. No Banksian line in the hind wings.

A single female specimen collected by Dr. George N. Wolcott May 1927 at Jacmel, Haiti. Length of fore wing 58 mm. width 9 mm. Total length 66 mm.

Psammoleon bistictus (Hagen).

Syn. Neur. N. Amer., Smiths, Msc. Colls., 1861, p. 235. (*Myrmeleon*).

Lower part of face and palpi light yellowish or amber. A black bar slightly beset with short white hair across the face in region of antennæ.

Vertex with two black transverse undulate carinae, between which there is a black and grayish color pattern. Three basal segments of antennae yellowish, prominently marked with dark brown; remaining segments nearly wholly light brown. Club of antennae very light brown, alternately banded with light to dark brown.

Prothorax nearly wholly brown except for some darker brown patches with two pairs of lighter areas dorso-laterally and a gray median line. Rest of thorax and abdomen predominately dark brown with lighter brown areas between, forming an intricate pattern. Tip of abdomen with prominent black setae.

Legs slender; coxae and femora of last two legs wholly yellowish with long stout gray setae and a few black ones. The first two pairs of legs prominently marked with brown. Hind pair almost entirely yellowish in color, sparsely beset with black and gray spines. Tarsi banded with black. Tibial spurs light brown in color, slightly curved, equal in length to the first three tarsal segments of the front and the first two segments of the other legs. Tarsal claws simple, shorter than tibial spurs.

Wings as illustrated in Figure 14. Stigmas whitish. Prominent black barring along R. and two black bars along cross veins, one in radio-medial area and a short one basally in cubital region.

Four specimens collected by the writer November to January, one of which was taken from a spider web on a ceiling of a porch. This and many other insects had been apparently attracted there by the light and became entangled in the web.

Length of front wing 27 mm., width is 6.5 mm. Total length head to tip of closed wing 31 mm. Expanse is 54 mm.

Austroleon indiges Walker.

A small, delicate, slender bodied, slender winged species, without prominent wing or body markings and resembling, superficially, some of the smaller damsel flies. Banks, who determined these specimens, stated that *Clathroneuria cubitalis* Navas of Cuba is a synonym.

Face yellowish, shining, brownish-black bar between and below the antennae, a circular, somewhat crescent-shaped grayish-black bar above the antennae, a narrow slightly crescent, yellow bar between the two spots joining the antennae. Vertex with a complex four-pointed blackish-brown bar extending from eye to eye with yellowish areas around the brown spot. Occiput with two dorso-lateral longitudinal, brown bands which extend posteriorly over the praescutum.

Antennae dark brownish, due to short brown setae, but each segment with a narrow yellowish ring, caused by absence of brown setae at both ends of each segment. Basal segment yellowish with brown clouding laterally. Club flattened, lighter and more yellow beneath; basal half nearly wholly brownish black.

Pronotum, except the praescutum, with five brown longitudinal bands, two lateral, two dorso-lateral and one median. These bands extend over the rest of the thorax, but are irregular, giving this region the appearance of having four broad, brown stripes with the intervening areas light yellowish.

Abdomen very long and slender, 28 mm. in length; brownish below, basal half largely yellowish above, distal half brown. Segments 1 and 2 very short, approximately equal in length; segment 3 the longest, 6 mm. long, yellowish with two brownish longitudinal spots dorsally, one anteriorly and one posteriorly; 4th segment similar except the brown on the sides extends dorso-laterally between the two dorsal spots and is visible dorsally, slightly broadened just below the middle and nearly wholly brownish black; 5th segment broadened anteriorally, very dark; segments 6 to 8 inclusive, are very dark brown. Anal appendages 2, gray, flattened, downward-curving projections, set with brown setae. Abdomen thickly beset with short brown setae, not obscuring the surface, however. About 9 pairs only of short black setae on the pro- and mesothorax.

Wings as illustrated in Figure 18. Length of front wing, 18 mm. Greatest width, 4 mm. Hind wing, 17 mm. Width, 3.5 mm.

Total length, head to end of abdomen, 31 mm.

A male, collected Cul de Sac plain May 12, 1927 by Dr. Geo. N. Wolcott and two males collected January 5, 1929 by the writer.

Myrmeleon insertus Hagen.

Synopsis Neur. N. Amer., Smiths, Misc. Colls. p. 233–234, 1861.

The most common species of myrmeleontid on the Cul de Sac plain region in Haiti. A fairly large species with somber markings, (See Plate II, Fig. 15). These diagnostic notes are given to supplement Hagen's description.

Head black from near fronto-clypeal suture to middle of vertex; portion immediately below antennae shining black, dull grayish black above. Two black spots on the clypeus. Palpi banded with light brown. Antennae entirely black except for a narrow yellow region on the basal segment and narrow intersegmental yellowish bands; black region rugose, sparsely beset with short coarse black setae. Club of same coloration. Upper surface of club deeply sunken, producing a dipper effect. Vertex with two dull black sub-median bands extending to pronotum, interrupted with yellow at their middle. Two pairs of longitudinal lateral dull black bars extending mesad from the compound eyes.

Three black longitudinal bands on the pronotum, a median one broadened near the middle and a pair of black lateral bands with two projections medianly. Remainder of thorax and entire abdomen almost wholly dull brownish black, sparsely beset with short decumbent glistening white hair. Last two segments of abdomen with a yellow spot distally on dorsum. Genitalia thickly beset with shining black, short, stout setae.

Wings as shown in Figure 15. Main longitudinal veins alternate brown and gray. Sc, R and Cu are prominently brown and gray spotted. Stigmas whitish.

Legs slender, yellowish. Femora with light brown band distally. Tibiae with brown longitudinal band dorsally. Each tibia with a pair of slightly curved tibial spurs, shorter than the first tarsal segment. First tarsus approximately equal in length to next two, tending to be a little shorter. Last tarsal segment as long as first three together, black distally. Claws simple, slightly curved; legs with few long black setae only.

Total length, wings folded, 32 mm. Length front wing, 28 mm. Width, 5.75 mm. Length hind wing, 27 mm. Width, 4.75 mm.

Fifteen specimens, about half of them reared. Some adults also taken at lights. Collected October to May. Larvæ collected at Sisal plantation, Hatte Lathan, December 15. Spun January 4. Emerged February 7.

Ascalaphidæ.

Five species of *Ascalaphids* from Haiti have been seen. Most of them were collected on a radio aerial on our home. The adults rested, usually, with the body close to the wire and with the wings and antennæ hanging downward in the characteristic position often described. One adult was taken on a rose bush and one larva was collected.

Ululodes macleayana venezolensis Van der Weele.

Monographisch Bearbeitet, Coll. Zoologiques, 1908, p. 103–104.

Five specimens, August to December, most common in August to November inclusive however. These specimens conform to the illustration and description of Van der Weele, pp. 103–104, very closely. The wings are shown in Figure 19. The hair on the head and body is predominately light brownish. The female lacks the blackish clouding in the hind wings below the stigma.

Two females deposited eggs, (Fig. 6) and some of the eggs hatched. The larvæ (Fig. 9) would not feed and became lost when put into sand.

Ululodes subvertens (Walker).

Brit. Mus. Cat. Neur., p. 437, 1853.

Two specimens taken from the Cul de Sac plain of Haiti near Port au Prince which conform rather closely to Van der Weele's description and illustration pp. 113–114. Hair on the head is largely white. One specimen collected by the writer

August 1929, one female collected by Dr. Wolcott, November 20, 1927. The wings of a specimen from Haiti are shown in Figure 17.

Ululodes sancti-domingi Van der Weele.

Monographisch Bearbeitet, Coll. Zoologiques, 1908, p. 115.

Three specimens, which conform to Van der Weele's account p. 115, collected by the writer. One collected in September, one in April, and the third specimen, which is in poor condition, is without data.

The hair on head and thorax is predominately black. The body color is black or brownish-black. The wing veins and stigmas are shining, dark, reddish-brown.

Ululodes banksi Van der Weele.

Monographisch Bearbeitet, Coll. Zoologiques, 1908, p. 115–116.

One specimen collected by Dr. Wolcott, May, 1925. Described by Van der Weele pp. 115–116. Wings are shown in Figure 21. The venation is very similar to *venezolensis*, Figure 19. The antennæ are predominately yellow. The hair covering of head and thorax is gray and black mixed, nearly equal in amount. The wing veins are shining brown but the stigmas are very light brown. The veins are lighter brown in the distal half of the wing.

One specimen without date. The brown coloring of the membrane of the wing makes this species easy to recognize. The hair on the head is grayish, black at tips. Specimen is smaller than Van der Weele's measurements. Front wings 25 mm. x 7 mm.

Coniopterygidae.

A single specimen only of this family was taken in Haiti. No special effort was made to collect *Coniopterygids* so this paucity does not indicate that they are rare. Dr. J. C. Myers stated to the writer that he saw them in numbers on evergreens in the region of Kenscoff.

Coniopteryx haitiensis n. sp.

Tribe Coniopterygini Enderlein.

This specimen keys out to Malacomyza in Bank's key, (p. 80, 1906) and to Coniopteryx in Enderlein's key (p. 6, 1908).

Coniopteryx appears to be the valid name for the genus. Cu 1 of the front wing is not sharply bent. The basal segments of the antennæ (Fig. 7b) are not elongated or are equal to only about two other segments and no sense organs were seen on the segments. A drawing of the wings is shown in Figure 7a. The prominent axillary lobe of the hind wing is diagnostic.

Head amber colored except a broad black bar on the front between the antennae extending from the clypeus to the middle of the vertex. Antennae filiform with 25 segments.

Body pinkish in color, bare, abdomen short, gray in color. Wings grayish white, membrane clothed with a fine scaly covering.

Legs without bristles, amber colored.

Length of front wing, 1.98 mm.; width, 9.46 mm.; length of hind wing, 1.76 mm.; width, 6.45 mm. Length of antennae, 1.03 mm. Total length, head to tip of folded wings, 2.58 mm.

Type mounted on a slide. A single female specimen, collected December 20, 1929 by beating the branches of a tree (*Inga vera*) near Damien, Haiti. Deposited in Museum of Comparative Zoology.

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EXPLANATION OF PLATES.[4]

PLATE I.

Fig. 1. Head and prothorax of third instar larva of *Chrysopa damiensis* Smith. This was the most common trash carrier seen. The middle marks on the head were not always clearly fused into a loop.

Fig. 2. Third instar larva of *Chrysopa exterior* Navas. This is a non-trash carrier of the *C. plorabunda* type, but the middle, black, triangular bar on the head is specific. × 7.

Fig. 3. Third instar larva of *C. thoracica* Walker, which is a dark trash-carrying type.

Fig. 4. Third instar larva of *C. dozeri* Smith. The larva is of the type of *C. rufilabris*, but this species has more red in the dorso-median area particularly of the thorax, ordinarily somewhat more than is shown in the drawing. × 7.

Fig. 5. Fully grown larva of *Leucochrysa haitiensis* Smith, showing an unusual head pattern and a very dark body coloration for a trash-carrying larva. The dorsal hooked setae, common to trash carriers, are not shown in the drawing.

Fig. 6. Egg of *Ululodes macleayana venezolensis* Van der Weele.

Fig. 7a. Wings of *Coniopteryx haitiensis* Smith.

Fig. 7b. Antenna of *Coniopteryx haitiensis* Smith. Venation after Withycombe: Entomologist, 1922, 4: 224–225.

Fig. 8. First instar larva of *Leucochrysa haitiensis* Smith. Note that there are only two spines from each lateral tubercle except the second and third thoracic ones which have three each as in Chrysopa larvae.

Fig. 9. Newly hatched larva of *U. venezolensis*.

PLATE II.

Fig. 10. Left wings of the type of *Micromus haitiensis* Smith.

Fig. 11. Right wings of a paratype of *Chrysopa damiensis* Smith.

Fig. 12. Right wings of type of *Nusalala damiensis* Smith. Note the dark brown line along the outer gradates.

Fig. 13. Wings of *Glenurus cerverai* Navas.

Fig. 14. Right wings of *Psammoleon bistictus* Hagen. The powdery effect is due to foreign materials on the wings.

Fig. 15. Right wings of *Myrmeleon insertus* Hagen.

Fig. 16. Right wings from the type of *Vella fallax* sub sp. *haitiensis* Smith. The brown and gray areas on the veins are not shown in the photograph.

Fig. 17. Right wings of *Ululodes subvertens* (Walk.).

Fig. 18. Wings of *Austroleon indiges* Walker.

Fig. 19. Right wings of *Ululodes macleayana venezolensis* Van der Weele. The black spots basad and distad of the stigma in the front wings are not wing markings, but foreign material on the wing surface.

Fig. 20. Right wings of *Leucochrysa haitiensis* Smith.

Fig. 21. Right wings of *Ululodes banksi* Van der Weele.

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[4]Drawing 6 by Fritz Maximilien, 7a and 7b by the writer and all of the others by Pierre Noel.

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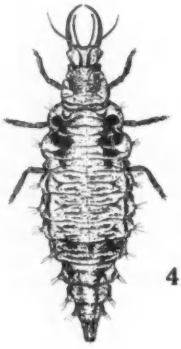

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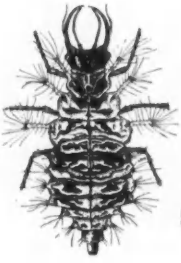

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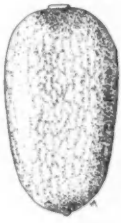

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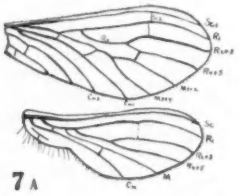

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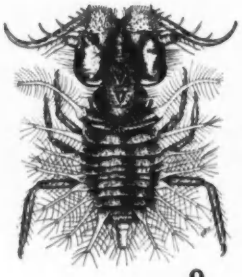

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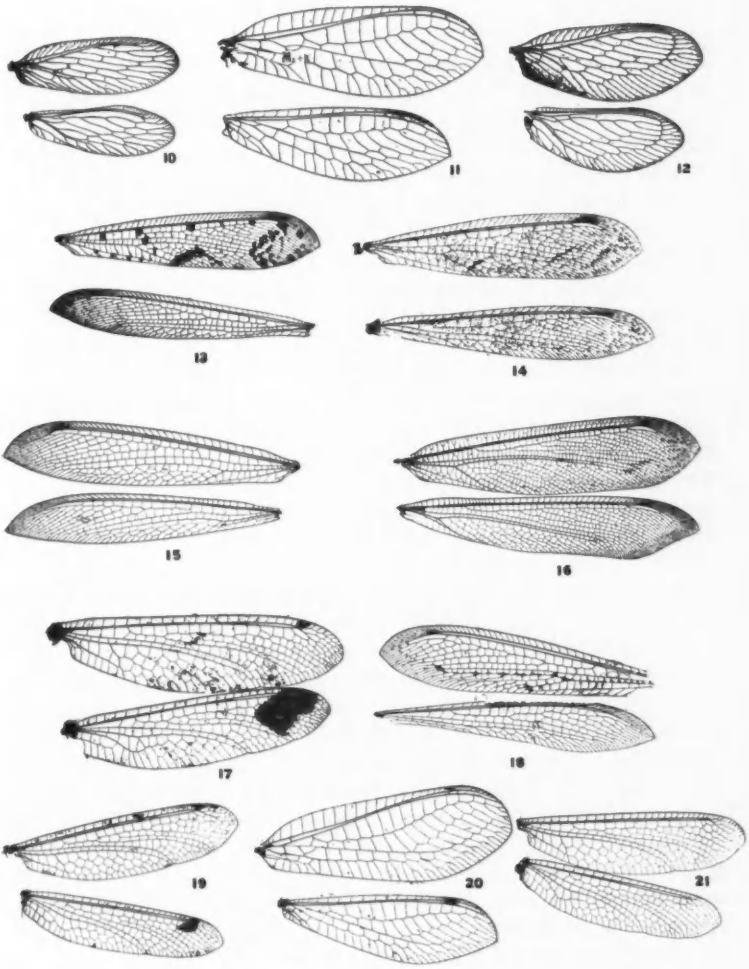
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KINESTHETIC SENSE OF INSECTS.*

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In spite of the large number of valuable observations which have been published concerning the behavior of insects, it is rather striking that the kinesthetic sense remains a neglected factor. In recent years a new theory of geotropism has been developed by Crozier and his school. This theory is in sharp contrast to the now obsolete statolith hypothesis of orientation to gravity. It is now beyond question that in a large number of diverse organisms, including mammals and insects (Crozier, 1929), the direction of the organism in a gravitational field is determined by the body weight acting upon the "tension receptors" in the supporting musculature of the limbs. The writer (Barnes, 1929, 1930a) has shown that the angle described by an ant crawling upon an inclined surface is a precise function of the sine of the angle of inclination of substratum. The insect turns until the "pull" of the body weight on both sides of the supporting musculature is reduced below threshold value. The same phenomenon has been observed in *Malacosoma* larvae, in *Tetraopes*, and several other insects. Unfortunately we have no knowledge of tension receptors in insects, either from the physiological or histological point of view. In rats, however, the muscle tension theory of geotropism is supported by a great deal of valuable evidence concerning the histology of the vertebrate muscle spindle and the nervous discharges produced by these sense organs when stimulated by tension. The present investigation was undertaken with the hope of discovering muscle tension receptors in Arthropods. The writer (Barnes, 1930b) has recently published an account of the physiology of the tension receptors in Crustacea and the present note deals with afferent impulses from insect muscle.

The work was carried on at the Biological Station in Bermuda during the summer of 1931. The apparatus employed con-

*Contributions from the Bermuda Biological Station for Research.

sisted of an amplifier, constructed of radio parts after a design by Professor A. Petrunkevitch, to whom the writer is greatly indebted for much helpful advice. Three Ux 240 wireless valves, having a high amplification factor (Mu=30) were connected to a power valve 171A (Mu=3), all of which were resistance coupled. In the absence of an oscillograph the amplifier was wired to a loud speaker. A resistance of two megohms was employed between the nerve and the ground wire. The nerve was placed across cotton points, soaked in physiological solution, leading from Ag–AgCl electrodes (unpolarizable). It was found that insect nerves survive an hour or more in seawater diluted two-thirds with distilled water. The metathoracic legs of large specimens of *Periplaneta* were cut off at the coxa and the entire nerve in the femur was carefully dissected out in the solution. As far as possible no metal instruments were allowed to come in contact with these unmedullated fibers; fine glass hooks were found to be very suitable for manipulating the nerve trunk. The femur was held firmly by a muscle clamp and the nerve was placed gently across the cotton electrodes. A natural form of stimulus was used throughout, i. e., bending the various segments of the leg.

It was very gratifying to find that the slightest movement of the limb produced a discharge of sensory impulses which were led off through the electrodes and reproduced faithfully by the loud speaker. The sound resembled very closely the discharges from the muscle spindles of the frog and the muscle receptors of the crab and lobster. It is obvious that the presence of these afferent action currents in the femural nerve is a beautiful confirmation of Crozier's theory of geotropic orientation. The frequency of the discharge was proportional to the extent and rapidity of the leg movements.

It is not advisable at present to attempt to report other characteristics of these afferent impulses. Further work is necessary to determine the rapidity of the adaptation to the stimulus. Following the well-known terminology of Adrian (1928) rapid adaptation of the sense organ signifies that it does not give rise to a persistent discharge of impulses during a persistent stimulus. In other words, the polarized membranes concerned are discharged during the initial period of stimulation. The question of adaptation of tension receptors is not without significance for the problem of maintained posture. In a

previous communication (Barnes, 1930c) it has been pointed out that marine Crustaceans which are not capable of maintaining a standing posture have tension receptors which exhibit rapid adaptation in contrast to the muscle spindles of vertebrates, whose slow adaptation, or the ability to maintain a persistent discharge, enables the animal to hold a standing posture while the body weight is pulling on the supporting musculature. In the preparations studied, the adaptation of the tension receptors in the cockroach appeared to be rather rapid which seems incompatible with the habit of the insect of retaining a standing posture for long periods. We expect to return to this problem in the near future. The present report is to be regarded as further evidence supporting Crozier's theory of geotropic orientation which of course requires the presence of sense organs responding to tension.

Preliminary histological investigations were undertaken to locate the sense organs involved but vital staining with methylene blue failed to reveal structures in the muscle which might be regarded as sensory endings. In Crustacean muscle the author has been unable to find anything resembling the muscle spindles of vertebrates and in the crab and lobster it is not improbable that the movements of the limb give rise to afferent impulses which take their origin in the flexible integument at the joints which is folded or unfolded at every movement. The writer would be very glad to hear of any papers dealing with sensory organs in the muscles of insects.

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THE APHIDAE OF COLORADO.

PART I.

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The object in preparing this paper has been to give as complete a list as possible of the aphids infesting both the native and the introduced plants occurring in the State of Colorado, along with brief notes on food plants and life histories.

While we have endeavored to correctly determine all the species listed, we are well aware that there will be other students of the group who will not agree with us in all cases. We have not been so much concerned about this as we have about making clear the characteristics of the species being considered in each case. We have, therefore, taken considerable pains in presenting brief descriptions and carefully drawn figures to show important structural characteristics.

Keys are given to aid the beginner, especially, in the determination of species, and the list of host plants included in the index will enable anyone to determine quickly all the species of aphids that we have taken on any species of plant.

The plan of classification used by A. C. Baker in his paper on "Generic Classification of the Hemipterous Family Aphididæ," (U. S. Dept. of Agri. Bul. 826, 1920) has been followed rather closely.

We are indebted to nearly every aphid specialist we know, in this country or Europe, for assistance in one way or another, in the preparation of this report on our aphid studies. Instead of attempting to list their names together here, we have endeavored to give credit in the write-up accompanying the species. However, we wish especially to acknowledge our great obligation to the late Mr. L. C. Bragg, who, as a great lover of nature and an enthusiastic worker, collected fully one-third of all of the material upon which this paper is based.

All of the illustrations are by the junior author.

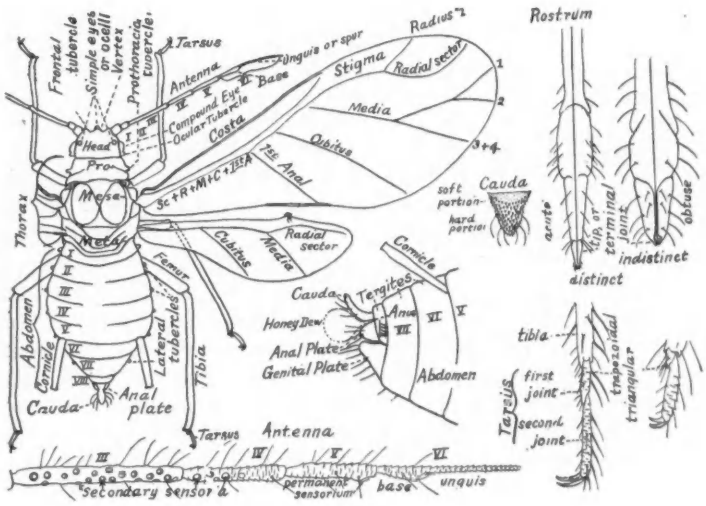

FIGURE 1.

Aphid Anatomy, illustrating structures mentioned in this paper. The rostrum is considered to be five-jointed following the terminology of Mordvilko (Ins. Hemip., Vol. 1, Liv. 1, int. p. 79, 1914). The tip or terminal joint is accordingly the 5th., the preceding tapering joint is the 4th. and the thick broad joint the 3d.

When abbreviations are used in any of the figures showing aphid structures, they are used as follows:

A.—Antenna.
Al.—Alate.
A. P.—Anal plate.
Apt.—Apterous.
Ca.—Cauda.
Co.—Cornicle.
E.—Eye.
Fund.—Fundatrix.
Ovip.—Oviparous.
R.—Rostrum.
S.—Stigma.
Ta.—Hind tarsus.
Ti.—Hind tibia.
T. S.—Tibial spines on middle of hind tibia.
U.—Unguis.
Ver.—Vertex.
Viv.—Viviparous.
I, II, etc.—Antennal joints of corresponding number.
♂—Male.
♀—True female, always oviparous.

Superfamily **Aphoidea.**

The *Phylloxeridae*, or *Adelgidae*, were formerly placed under the family *Aphidae*. Recently, however, two distinct families are recognized and these together comprise the superfamily *Aphoidea*. This paper deals with the *Aphidae** only.

KEY TO FAMILIES OF APHOIDEA.

A. Females always oviparous. Antennae 3–5 jointed, shorter than head in apterae. Radial sector absent, stigmal vein formed by media; media simple.....**Phylloxeridae**

AA. Summer females viviparous. Antennae usually 6-jointed, longer than head in apterae. Radial sector present; media branched in most species.....**Aphidae**

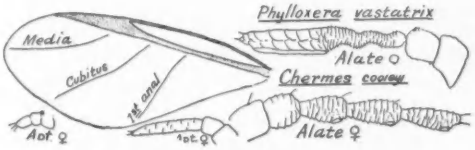

FIG. 2. Phylloxeridae.

Family **Aphidae.**

Characters.—Tarsi 2-jointed. Antennæ usually 6-jointed, terminal segment with a slender prolongation or unguis. Cornicles usually present. Stigmal vein is the radial sector. Agamic forms never oviparous. Last segment of abdomen bearing a cauda.

KEY TO SUBFAMILIES OF APHIDAE.

A. Exposed on plants. Antennae, cauda and cornicles well developed. Sensoria on antennae circular or oval. Wing veins not reduced. Wax glands not abundant.

B. Radial sector arising from stigma.....**Aphinae**

BB. Radial sector arising proximal of stigma.....**Mindarinae**

AA. Concealed under secretions, or in folded leaves, in galls or on underground roots. Antennae, cauda and cornicles more or less reduced or wanting. Sensoria on antennae usually transverse or annular.

B. Aleyrodiform stages not found.....**Eriosomatinae**

BB. Aleyrodiform stages common.....**Hormaphinae**

*Not used in the restricted sense of Borner (Arch. Klass. Phylog. Ent. 1930) who separates the *Eriosomatinae* as a distinct family.

Subfamily **Aphinae.**

Characters.—Antennæ always longer than head and thorax, sometimes longer than body. Cornicles evident, either as cylindrical tubes or as raised rims. Cauda usually well developed. Compound eyes developed in apteræ. Sensoria on antennæ circular or oval. Oviparæ usually laying several eggs. Living exposed on plants.

KEY TO TRIBES OF APHINAE.

A. Cornicles on broad shallow cones. Radial sector usually straight.
  B. Cornicles and antennae hairy (except in *Essigella*). Radial sector straight (except in *Lachnus* and ANOECINA). Unguis thick, much shorter than base of VI. (Page 830).....**Lachnini**
  BB. Cornicles and antennae not noticeably hairy. Radial sector curved. Unguis slender, nearly as long as base of VI. (Not recorded from Colorado.).....**Setaphini**
AA. Cornicles truncate or rather elongate or absent. Radial sector never straight.
  B. Cornicles bearing long hairs. (Not recorded from Colorado)..**Greenideini**
  BB. Cornicles never with long hairs.
    C. Thorax of alatæ with dorsal lobes not prominently developed. Oviparae small, often laying but one egg; large wax plates present. (Not recorded from Colorado).....**Thelaxini**
    CC. Thorax of alatae with lobes prominently developed. Oviparae laying several eggs. Large wax plates usually absent.
      D. Cornicles truncate or elongate, rarely rings or pores; when elongate the cauda is knobbed and anal plate bilobed, or antennae prominently hairy. (Page 882).....**Callipterini**
      DD. Cornicles not truncate, usually elongate. Cauda never knobbed. Antennae with only a few spine-like hairs. (Part II).....**Aphini**

Tribe **Lachnini.**

Characters.—Frontal tubercles lacking. Antennæ and body usually hairy. Secondary sensoria circular. Unguis much shorter than base of VI, if not, stigma greatly elongated. Cornicles mere rims, usually on broad hairy cones, or if not, stigma more or less elongate and radial sector straight. Cauda always broader than long, apparently semilunar and rounded but really ending in upturned point. Anal plate rounded, entire.

KEY TO SUBTRIBES OF LACHNINI.

A. Hind tarsi never more than one-third length of tibiae.
  B. Hind first tarsal joint triangular, hardly longer than wide. (Page 831) **Anoecina**
  BB. Hind first tarsal joint distinctly trapezoidal, much longer than wide.
    C. Body narrow. Cornicles mere rings. (Page 835).....**Eulachnina**
    CC. Body not narrow. Cornicles on hairy cones or, if not, rostrum lance-like.
      D. Radial sector straight, stigma not elongated to apex of wing. Tip of rostrum conspicuous, distinctly separated. (Page 841)...**Cinarina**
      DD. Radial sector more or less curved or stigma greatly elongated, attaining apex of wing. Tip of rostrum inconspicuous, not distinctly separated. (Page 875).....**Lachnina**
AA. Hind tarsi greatly elongated, second joint more than half as long as tibia; first tarsal joint minute. (Page 880).....**Tramina**

Subtribe **Anoecina.**

Characters.—Antennæ 6-jointed, with long hairs and protruding subcircular or oval sensoria. Fore wings with stigma short and broad; radius curved, arising some distance proximally to tip of stigma; media once branched, not faint. Wings hyaline. Tarsi short and thick, Aphis-like; first joint of tarsi triangular. Cornicles on shallow hairy cones.

This group is placed under the *Pemphiginæ* by some but the characters of the cornicles, cauda, anal plate, hairs and sensoria seem to the writers to ally it to the *Lachnini*. The genus *Nippolachnus*, with its long stigma, seems to form a connecting link with that tribe, though it differs in the curved radius.

KEY TO GENERA OF ANOECINA.

A. Head divided, ocular tubercles absent. Stigma long and straight, **Nippolachnus**

AA. Head not divided. Ocular tubercles prominent. Stigma short and rounded..... **Anoecia**

[Genus **Nippolachnus** Matsumura.]

Type, *Nippolachnus pyri* Matsumura. (Matsumura, Jour. Coll. Agr. Tohoku Univ., Vol. 7, pt. 6, p. 382, 1917).

Characters.—Antennæ 6-jointed, with many hairs; sensoria prominent and protruding. Head divided. Ocular tubercles not prominent. Stigma long and narrow. Mediæ once branched. Cornicles on large broad cones entirely covered with hair. Spring forms free, migrating in summer to alternate hosts. Sexes small, males winged. Unknown in Colorado.

Genus **Anoecia** Koch.

Type, *Aphis corni* Fabricius. (Koch, Die Pflanzenlause Aphiden, 1857, p. 275).

Characters.—Vertex rounded; head not divided. Frontal tubercles absent. Antennæ inserted laterally or slightly ventrad; 6-jointed; covered with hairs; unguis much shorter than base of joint VI; sensoria subcircular or elongate. Fore wings with mediæ once branched; stigmæ short and thick. Hind wings with two cross veins. Cornicles on broad hairy cones. Cauda rounded, broader than long. Anal plate entire. Sexes apterous, with beaks and feeding. Oviparous female laying one to four eggs. Spring forms free, summer forms usually on roots.

Genotype, *Anoecia corni* (Fabricius). (See below).

KEY TO SPECIES OF ANOECIA.

A. Sensoria narrow elongate, number, 6-19 on joint III of alate viviparae. Summer apterae with antennal joint III .30 mm. long. (Page 832)....**corni**
AA. Sensoria oval, numbering 0 to 8 on antennal joint III of alate viviparae. Summer apterae with antennal joint III less than .30 mm. long.
B. Sensoria in alatae nearly always large and uniform. Antennal joint III in Summer apteræ shorter than .15 mm. (Page 833).....**querci**
BB. Sensoria in alatae rarely large. Antennal joint III in summer apterae longer than .15 mm.
C. Unguis slender and finger-like. Apterae black. (Page 833).....**graminis**
CC. Unguis stout, rather conical. Apterae yellow, usually with dusky markings.
D. Antennal joint III of apterae .18 mm. long. On *Oenothera* roots. (Not taken in Colorado.).....**oenotherae**
DD. Antennal joint III of apterae .24 mm. long. On *Setaria* roots. (Page 834).....**setariae**

[Genotype **Anoecia corni** (Fabricius).]

Fabricius, Systema Entomologia, p. 736, 1775.

For fuller description see Baker, A. C., Ent. News, Vol. 27, p. 359, 1916.

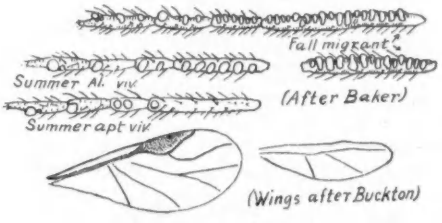

FIG. 3. *Anoecia corni.*

Color.—Brown to black in viviparæ, alatæ with anterior abdominal segments pale; legs dark.

Measurements.—Apterous vivipara.—Body 2 to 2.3 mm. long; joint III .32 to .35 mm.; IV .13 mm.; V .13 mm.; VI .13 + .05 to .06 mm. Alate vivipara, spring and summer form.—Same as aptera. Fall migrant.—Antennal joint III .46 to .51 mm.; IV .16 to .176 mm.; V .16 to .176 mm.; VI .14 to .176 + .064 mm.

Structural Characters.—Secondary sensoria oval to narrow transverse, 12 to 19 on III, 4 to 6 on IV and V in fall migrant; early summer migrant, 6 or 7 on III and oval. Hairs pointed and long. Rostrum attaining third coxæ. Male apterous.

Hosts.—On *Svida* (Syn. *Cornus*), on leaves and twigs; and on *Gramineæ*, on roots, also in ants' nests. Not recorded from Colorado. (Data from Baker, 1916, and Theobald, Aphid. Gr. Brit., Vol. 3, 1929.)

Anoecia graminis Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. Amer. Vol. 17, p. 3, 1924.

Color.—Apterous viviparæ—Dull black with dusky bands; with slight pulverulence; appendages dark.

Measurements.—Apterous summer viviparæ.—Body 2 by 1.25 mm.; hind tibiæ .65 to .80 mm.; antennæ .65 to .80 mm.; joint III .21 mm.; IV .11 mm.; V .14 mm.; VI .16 + .05 mm.; cornicles .13 mm. in diameter at base of cone. Alate vivipara.—Same as aptera or slightly larger in all parts.

Structural Characters.—Secondary sensoria protruding, oval, 3 on III, 4 on IV and 4 on V in alatæ; in apteræ 0 to 1 on III, 0 to 2 on IV, 0 to 3 on base of VI. Unguis slender and finger-like. Hairs on hind tibiæ, semi-erect to erect, moderately numerous, length .05 to .06 mm., about the same as diameter of tibiæ in apteræ; in alatæ, .10 mm. long, nearly twice as long as diameter of tibia. Rostrum rather broad, barely attaining third coxæ. Oviparæ not showing hind tibiæ swollen or with sensoria.

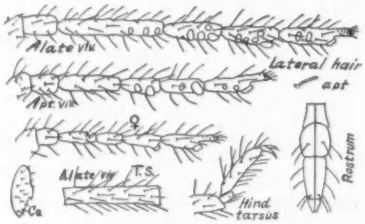

FIG. 4. *Anoecia graminis.*

Collections.—On *Hordeum* sp. on roots. Recorded from the state at Fort Collins and Cherokee Park; apterous summer viviparæ, Sept. 6 to 24; alate viviparæ, Sept. 13; oviparæ, Sept. 6, 16 and 24; 4 collections, 23 specimens; rare.

Taxonomy.—This species differs from *A. querci* (Fitch) in the lengths and sensoriation of the antennal joints, the more slender unguis, the color of the apteræ and presence of oviparæ on grass roots.

Anoecia querci (Fitch).

Fitch, Fifth Rept. Nox. & Ben. Ins., N. Y., p. 804, 1859. *Eriosoma.*

For fuller description see Baker, Ent. News, Vol. 27, p. 359, 1916.

Color.—Pale greenish or whitish to reddish-brown; with black bands and quadrate dorsal patch on abdomen in summer and fall alatæ; appendages black.

Measurements.—Apterous summer vivipara.*—Body 1.7 mm.—Antennal joint III, .13 mm.; IV .06 mm.; V .08 mm.; VI .096 + .048 mm. Alate vivipara.—Body 2 to 2.5 mm.; hind tibiæ .7 to 1 mm.; hind tarsi .15 mm.; antennæ .9 to 1 mm.; joint III .20 to .33 mm.; IV .08 to .12 mm.; V .09 to .12 mm.; VI .08 to .12 + .03 to .05 mm.; cornicle .17 mm. in diameter at base of shallow cone.

Structural Characters.—Secondary sensoria varying greatly in size, oval, almost circular, 0 to 8 on III, and 2 or 3 on IV, and V in fall migrant; in spring migrant 2 or 3 on III, or sometimes absent; absent in apteræ. Unguis stout and club-shaped. Hairs numerous, long and curved, covering antennæ and body. Rostrum attaining third coxæ. Mediæ once branched. Oviparæ not showing hind tibiæ swollen or with sensoria. Males apterous, secondary sensoria not evident on antennæ.

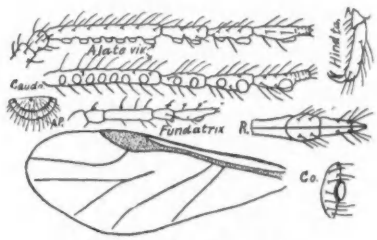

FIG. 5. *Anoecia querci.*

Collections.—On *Quercus*, *Svida stolonifera* (Syn. *Cornus*), on leaves and stems as winter host, and roots of grasses as summer host. Recorded from the state only on *Svida stolonifera*, at Fort Collins, Delta and Cherokee Park; fundatrices, April 25; apterous summer viviparæ not taken; alate viviparæ, Sept. 2 to Oct. 28; sexuales, Oct. 1 to 22; 17 collections; common.

Taxonomy.—This species has not been recorded in Colorado on its summer host, the grasses. This fact would seem to throw suspicion on the validity of the two species of *Anoecia*, namely *setariæ* and *graminis* taken from grasses. The characters of these species seem, however, to be distinct. These three forms are accordingly held as distinct until further investigation proves otherwise.

Anoecia setariae Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 4, 1924.

Color.—In viviparæ pale-yellowish or greenish with slight dusky dashes dorsally and laterally.

*From description by Baker, (1916).

Measurements.—Apterous summer vivipara.—Body 1.9 mm.; hind tibiæ .60 mm.; antennæ .60 to .65 mm.; joint I .07 mm.; II .06 mm.; III .24 mm.; IV .09 mm.; V .11 mm.; VI .11 + .04 mm.; cornicles .12 mm. in diameter at base of cones. Alate vivipara.—Same as aptera or with slightly longer antennæ and tibiæ.

Structural Characters.—Secondary sensoria oval, strongly convex, 2 to 5 on III, 2 on IV and 1 on V in alate viviparæ; absent in apteræ. Unguis stout and finger-like to conical. Hairs pointed and fine on hind tibiæ, drooping to semi-erect, .05 mm. long, hardly longer than diameter of tibiæ in alatæ. Rostrum rather slender and acute, attaining first abdominal segment. Many intermediate forms were taken.

Collections.—On *Setaria* sp., on roots. Recorded from the state at Fort Collins; apterous summer viviparæ, Aug. 12 to Sept. 21; alate viviparæ, July 21 to Sept. 21; 9 collections; rare.

Taxonomy.—This species is very close to *A. oenotherae* Wilson and may be identical, but has not been taken on *Oenothera* in Colorado. From *A. querci*, it differs in the absence of black dorsal patch on abdomen and fewer secondary sensoria in fall alate viviparæ.

FIG. 6. *Anoecia setariae.*

Subtribe **Eulachnina.**

Structural Characters.—Body narrow and elongate, hardly broader than head. Eyes prominent, lacking tubercles. First joint of hind tarsi elongate, outer side .66 as long as inner side. Cornicles shallow, not on hairy cones. Rostrum obtuse. Unguis apparently bearing primary sensorium. Wings hyaline; radial sector straight, arising at lower distal angle of stigma. Living on needles of *Conifera.*

KEY TO GENERA OF EULACHNINA.

A. Antennae 6-jointed, bearing long stout spines.....**Eulachnus**
AA. Antennae 5-jointed, bearing minute bristles or naked. (Page 838)..**Essigella**

Genus **Eulachnus** Del Guercio.

Type, *Lachnus agilis* Kalt. (Del Guercio, Rivista Patol. Vegetale, n. s., Vol. 3, p. 329, 1909).

Structural Characters.—As given for *Eulachnini.* Also antennæ 6-jointed, primary sensorium proximal to unguis. Hairs are long stout spines. Mediæ faint, usually once branched. Claws simple. Living on needles of *Pinus.*

[Genotype **Eulachnus agilis** (Kaltenbach).]

Kaltenbach, Mon. der Pflanzenlause, p. 161, 1843. *Lachnus.*

Color.—Apterous and alate viviparæ.—Pale green to yellowish with brown specks at bases of hairs; cornicles dusky; more or less pulverulent, legs yellowish-green.

Measurements.—Apterous vivipara.—Body 1.7 to 1.9 mm., narrow; legs long; antennæ not half the body in length; joints in following proportions; III, 60; IV, 35; V, 41; VI, 36; hind tibiæ 2 mm.; hind tarsi .47 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Cornicles small elevated rings. Secondary sensoria of unequal size, 6 to 9 on III, and 0 to 4 on IV in alate viviparæ none in apteræ unless 1 on IV. Hairs long and bristle-like. Rostrum reaches second or third coxæ. Mediæ once forked. Males alate.

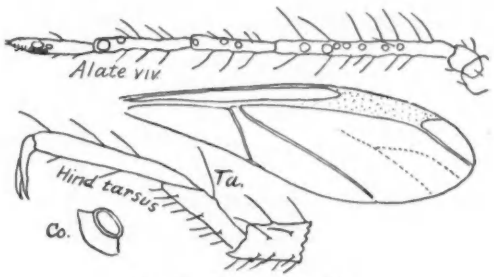

FIG. 7. *Eulachnus agilis.*

Collections.—On *Pinus sylvestris, halepensis,* and *pinaster,* on tender needles. [Data from Del Guercio, (1909) and Theobald, (Aph. Gr. Brit., Vol. 3, 1929).] Not recorded in Colorado.

Taxonomy.—This form is given as *L. agilis* Kalt. by Theobald (1929), Del Guercio (1909), Buckton (Mon. Br. Aphides, Vol. 3, 1881), Jackson (Scott. Nat., Sept. 1919), Mordvilko (Ann. d. Mus. Zool. Acad. Imp. Sci, 1908), and J. Davidson (Br. Aphides, 1925). Van der Goot (1915, Beit. z. Kenntid Holl. Blattlause, p. 389) describes a form which lacks secondary sensoria on antennal joint III in alate viviparæ. Kaltenbach did not note sensoriation in his descriptions.

Eulachnus rileyi (Williams).*

Williams, "Aphididae of Nebraska," Univ. Studies, Vol. 10, No. 2, p. 24, 1911. *Lachnus.*

Color.—Olive-brown; somewhat powdery; cornicles black; legs dark.

*Listed as "*Lachnus* near *agilis*" by Gillette, 1909, Jo. Ent., Vol. 2, p. 385.

Measurements.—Apterous summer vivipara.—Body 2 to 2.6 by .6 mm.; hind tibiæ 1.5 to 2 mm.; first joint of hind tarsi .08 mm. on outer side .11 mm. on inner side; second joint .21 mm.; antennæ 1.2 mm.; joint III .42 to .50 mm.; IV .24 to .28 mm.; V .27 to .30 mm.; VI .13 to .17 + .04 to .06 mm.; cornicles mere rings without conical base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria absent in both alate and apterous viviparæ, except 1 on IV. Unguis cylindrical or finger-like and blunt. Hairs heavy and spine-like, sparse on body, moderately numerous on appendages, on outside of hind tibiæ, at angle of 45 degrees, .10 mm. long, more than twice as long as diameter of tibia in apteræ; in alatæ .08 to 12 mm.; twice, or more, as long as diameter of tibiæ; hairs on inner side finer and shorter. Rostrum obtuse, attaining third coxæ. Mediæ faint, once forked, rarely simple. Males alate.

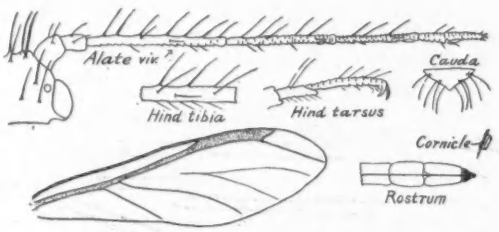

FIG. 8. *Eulachnus rileyi.*

Collections.—On *Pinus ponderosa* var. *scopulorum*, on needles. Taken in Colorado at Denver; apterous and alate summer viviparæ, Sept. 10; sexuales, Oct. 7; 2 collections; rare or just being introduced; not taken in the wilds.

Taxonomy.—This species may be a synonym of *L. agilis* Kalt. but is determined as distinct on account of the absence of secondary sensoria on antennal joint III. These are reported present by Del Guercio (1909) and Kaltenbach (1843). Van der Goot (1915), however, reports none except on IV and slides sent us by him agree with this. No variation in this character is mentioned. Kaltenbach did not mention sensorial characters so it is impossible to decide which of these conditions is typical. It accordingly seems best to give our form the American name for the present.

Genus **Essigella** Del Guercio.

Type, *Lachnus californicus* Essig. (Del Guercio, Rivista Patol. Vegetale, n. s., Vol. 3, p. 329, 1909).

Characters.—Body elongate and narrow, parallel sided. Head much broader than long, eyes prominent, ocular tubercles absent. Antenna of five segments, bearing only a few minute bristles. Unguis bearing primary sensorium. Mediæ faint, once branched or simple. Rostrum broadly obtuse. Cornicles mere rings, not on hairy cones. Claws bifurcate. Living on needles of pines, especially between needles at bases; very quick and active.

Genotype, *Essigella californica* (Essig). (See below.)

KEY TO SPECIES OF ESSIGELLA.

A. Tibial hairs* not longer than half of diameter of tibia. (Page 840)...**hoerneri**
AA. Tibial hairs not shorter than diameter of tibia.
  B. Tibial hairs about same length as diameter of tibia. (Page 841).....**pini**
  BB. Tibial hairs much longer than diameter of tibia.
    C. Tibial hairs 1.5 to twice as long as diameter of tibia. Page (839)..**fusca**
    CC. Tibial hairs distinctly longer than twice diameter of tibia. (Page 838), **californica**

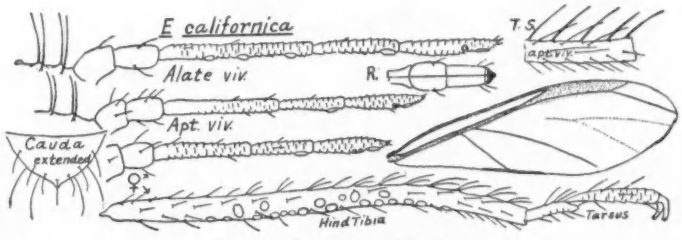

FIG. 9. *Essigella californica.*

[Genotype **Essigella californica** (Essig).]

Essig, Pom. Jour. Ent., Vol. 1, p. 1, 1909. *Lachnus.*

Color.—Alate and apterous viviparæ.—Pale green to yellowish, speckled with dusky at bases of hairs; with slight pulverulence; legs pale brownish or slightly dusky.

Measurements.—Apterous vivipara.—Body 2 by .6 mm.; hind tibiæ 1.2 mm.; first joint of hind tarsi .07 to .09 mm. on outer side, .10 to .12 mm. on inner side; second joint .20 mm.; antennæ .60 to .66 mm.; joint III .20 to .25 mm.; IV .11 to .14 mm.; V .08 + .05 mm.; cornicles mere rims, without mammiform base. Alate vivipara.—Body 2 to 2.2 by .50 mm.; hind tibiæ 1.3 to 1.9 mm.; first joint of hind tarsi .12 mm. on outer side, .16 mm. on inner side; second joint .25 mm.; antennæ .80 mm.; joint III .26 to .32 mm.; IV .15 to .17 mm.; V .12 + .04 to .05 mm.

*"Tibial hairs," wherever mentioned, refers to hairs on outer side of middle of hind tibiae.

Structural Characters.—Secondary sensoria large, convex, not tuberculate, 2 to 4 on III, scattered along most of joint, absent on other joints; absent in apteræ. First and second pairs of tibiæ much shorter than hind pair. Hairs pointed on antennæ, .01 mm. long; on outside of hind tibiæ spine-like, at angle of 45 to 60 degrees, .09 to .10 mm. long, 2 to 3 times as long as diameter of tibia in apteræ; in alatæ .10 to .12 mm., 3 to 4 times as long as diameter of tibia; on body slightly shorter and sparse; on vertex .06 to .07 mm. in apteræ, .08 to .09 mm. in alatæ. Rostrum obtuse, attaining third pair of coxæ. Mediæ once branched. Males unknown.

Collections.—On *Pinus contorta* var. *murrayana*, rarely *scopulorum*, in tender tips on needles, near bases, solitary. Taken in the state in hills above Bellvue; fundatrices, May 24; apterous summer viviparæ, June 6 to 14 and Oct. 9; alate viviparæ, June 16 to Oct. 9; oviparæ, Oct. 2 to 9; 6 collections; seemingly rare.

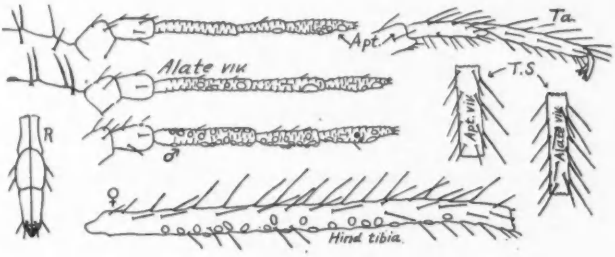

FIG. 10. *Essigella fusca.*

Essigella fusca Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 6, 1924.

Color.—Viviparæ.—Pale greenish or glaucous green, with dorsum marked with dusky spots often coalesced into bands or one solid patch fading out on head and pronotum; legs mostly dusky to blackish.

Measurements.—Apterous summer vivipara.—Body 2 to 2.2 mm. by .5 to .8 mm., parallel sided; hind tibiæ .8 to 1.15 mm.; first joint of hind tarsi .09 to .10 mm. on outer side, .12 to .13 mm. on inner side; second joint .18 to .20 mm.; antennæ .45 to .55 mm.; joint III .13 mm.; IV .07 to .09 mm.; V .07 to .08 + .03 to .09 mm. Alate vivipara.—Body 1.7 by .75 mm.; hind tibiæ 1.05 to 1.3 mm.; antennæ .57 mm.; joint III .15 to .23 mm.; IV .10 to .13 mm.; V .07 to .10 + .03 to .05 mm.

Structural Characters.—Cornicles mere rims without conical base. Secondary sensoria in alate viviparæ, 2 to 3 on III, none on IV or V; absent in apteræ. Unguis cylindrical blunt, bearing primary sensorium. Hairs slightly capitate; on hind tibiæ at angle of 45 to 60°, .06 to .08 mm.

long, 1.5 times as long as diameter of tibia in apteræ, about twice in alatæ; on antennæ .01 mm. long and sparse; on vertex .05 mm. long and pointed. Mediæ once branched, rarely simple. Rostrum attaining third coxæ. Males apterous.

Collections.—On *Pinus ponderosa* var. *scopulorum*, on needles at bases. Taken in Colorado near Estes Park, Bellvue, Log Cabin, Fort Collins, Denver and South St. Vrain Canon; fundatrices, May 8; apterous summer viviparæ, July 19 to Oct. 21; alate viviparæ, July 27 to Oct. 7; sexuales, Sept. 11 to Oct. 21; 14 collections; common but difficult to find on account of secluded location, protective coloration and agility in escaping.

Types in U. S. Nat. Mus., Cat. No. 41953; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species is distinguished from *E. californica* by the shorter tibial hairs and the dusky dorsal coloration in apteræ; from *E. pini* by the forked media, simple in only one wing in 23 examples.

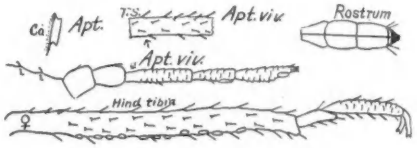

FIG. 11. *Essigella hoerneri.*

Essigella hoerneri Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 5, 1924.

Color.—Apterous viviparæ.—Apple-green posteriorly to yellowish anteriorly, without dusky spots at bases of hairs; legs pale.

Measurements.—Apterous vivipara.—Body 1.4 by .5 mm.; hind tibiæ .55 to .65 mm.; first joint of hind tarsi .06 mm. on outer side, .08 mm. on inner side; second joint .17 mm.; antennæ .42 mm.; joint III .11 to .13 mm.; IV .06 to .08 mm.; V .08 + .03 mm.

Structural Characters.—Cornicles mere rims without mammiform base. Secondary sensoria absent. Unguis cylindrical, blunt, bearing primary sensorium. Hairs slightly capitate, sparse, about .01 mm. long on outer side of hind tibia; almost invisible on antennæ, vertex and body, except posteriorly, where they are pointed and .05 mm. long. First and second pair of tibiæ somewhat thickened. Rostrum obtuse, attaining from third pair of coxæ to middle of abdomen. Alate viviparæ and males unknown.

Collections.—On *Pinus edulis* in abundance, rarely on *Pinus ponderosa* var. *scopulorum* and *Apinus flexilis;* on needles,

solitary. Taken in the state in Owl Canon in Larimer County; apterous summer viviparæ, Sept. 24 to Nov. 6; oviparæ, Oct. 27 to Nov. 6; 4 collections; abundant but difficult to find on account of solitary habits, small size, protective color and agility in escaping.

Types in U. S. Nat. Mus., Cat. No. 41952; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species is distinguished by the shortness of the tibial hairs and absence of dusky spots.

Essigella pini Wilson.

Wilson, Ent. News, Vol. 30, p. 6, 1919.

Color.—Viviparæ.—Pale greenish-yellow, with rows of dusky spots.

Measurements.—Apterous summer vivipara.—Body 1.6 to 2 by .45 mm.; hind tibiæ .70 to .95 mm.; first joint of hind tarsi .05 to .07 mm. on outer side, .10 to .12 mm. on inner side; second joint .17 to .20 mm.; antennæ .45 to .50 mm.; joint III .13 to .15 mm.; IV .07 to .10 mm.; V .09 + .03 to .05 mm. Alate vivipara not taken.

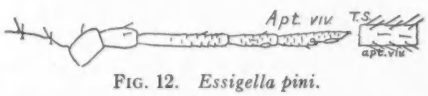

FIG. 12. *Essigella pini.*

Structural Characters.—Secondary sensoria absent in apteræ. Hairs slightly capitate on outer side of tibiæ at angle of 30 degrees; on hind tibiæ .03 to .04 mm. long, length equal to diameter of tibia, on vertex same as on tibiæ. Rostrum attaining first segment of abdomen.

Collections.—On *Pinus scopulorum*, rarely *contorta* var. *murrayana*, on bases of needles at tips of twigs. Taken in the state in foothills near Fort Collins, Bellvue, and Poudre Canon; fundatrix, May 24; apterous summer viviparæ, May 8 to Sept. 17; oviparæ, Oct. 13; 6 collections; rare.

Subtribe **Cinarina.**

Characters.—Usually large hairy forms, brown to black; often with pattern of white secretion. Cornicles usually on hairy cones. Rostrum lance-like. First joint of hind tarsus trapezoidal, outer side from .5 to .6 as long as inner side. Radial sector straight, almost reaching tip of wing. Ocular tubercles usually evident. Usually quick and spider-like in action. Living free on *Conifera*, on needles and bark of limbs and twigs.

KEY TO GENERA OF CINARINA.

A. Rostrum obtuse. Mediae once branched or simple. (Page 842). **Schizolachnus**
AA. Rostrum lance-like. Mediae once or twice branched. (Page 843)..... **Cinara**

Genus **Schizolachnus** Mordvilko.

Type, *Aphis pineti* Fabricius (Syn. *Aphis tomentosus* Villers). Mordvilko, Ann. Mus. Zool. l'Acad. Imp. des Sci., St. Petersburg, Vol. 13, p. 375, 1908.

Characters.—Antennæ 6-jointed. Rostrum with terminal joints short, obtuse. Ocular tubercles inconspicuous. Mediæ with only one branch or simple. Living on needles of *Conifera*. Only one species known in the state.

Schizolachnus pini-radiatae (Davidson).*

Davidson, Jour. Econ. Ent. II, p. 299, 1909. *Lachnus.*

Color.—In all forms.—Dark olive-green to slaty brown; thickly covered with flocculent secretion; legs and antennæ dusky.

Measurements.—Apterous summer vivipara.—Body 2 to 2.5 mm.; hind tibiæ 1.3 to 1.6 mm.; first joint of hind tarsi .05 mm. on outer

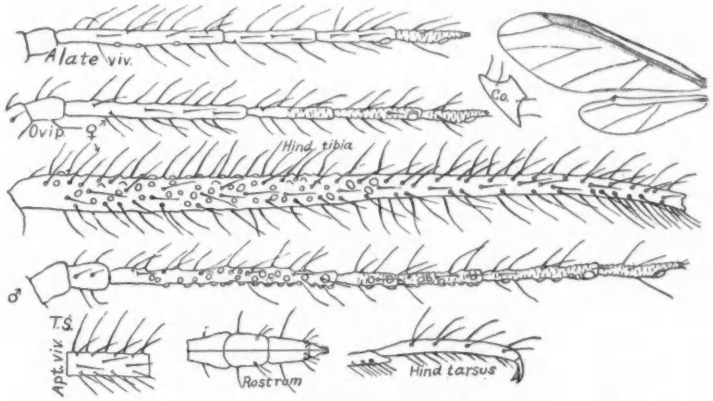

FIG. 13. *Schizolachnus pini-radiatae.*

side .09 mm. on inner side; second joint .30 to .37 mm.; antennæ 1.1 to 1.2 mm.; joint III .45 to .50 mm.; IV .22 to .28 mm.; V .20 to .24 mm.; VI .12 to .15 + .03 to .04 mm.; cornicles .12 to .15 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Cornicles mammiform, with flange, and bearing a few long hairs. Rostrum obtuse, attaining between second and third coxæ. Hairs attaining .15 to .18 mm. on outer side of hind

*This is the species published by Gillette (1917, Ann. Ent. Soc. Amer., Vol. 10, p. 140) as *Lachnus tomentosus*. Specimens determined as *L. tomentosus* sent by N. Cholodkovsky and P. Van der Goot are smaller in all measurements, hairs especially, and show the hind first tarsal joint as one-third of second, and Del Guercio's drawing ("Lacnidi Ital." Redia Vol. 5, fasc. 2, Tav. 14, fig. 128, 1909), is in accord with this. The Colorado examples show first joint as only one-fourth of the second. The European form also has 3 to 8 sensoria on antennal joint III of alate viviparae, while the Colorado form shows 0 to 3.

tibiæ, or over three times as long as diameter of tibiæ; on antennæ as long as twice diameter of antennal joints. Secondary sensoria round, 0 to 3 on III in alate viviparæ, absent in apteræ. Males alate. Mediæ usually twice forked but occasionally simple.

Collections.—On needles of *Pinus ponderosa* var. *scopulorum* and *contorta* var. *murrayana*. Recorded from the state in foothills about Fort Collins, Boulder, Livermore, Ouray, Colorado Springs, Denver, Estes Park, and Greeley; fundatrices, April 7 to May 22; apterous viviparæ, May 28 to Oct. 2; alate viviparæ, May 28 to July 18; oviparæ, Sept. 27 to Nov. 25; males, Sept. 27 to Oct. 23; 32 collections; common.

Taxonomy.—This form differs slightly from specimens in the collection of Stanford University taken on *Pinus radiata*. The differences are, slightly longer and stronger hairs and more numerous sensoria, 3 to 8 on antennal joint III in alate viviparæ of the California examples. These differences do not seem sufficiently distinct, considering the small number of specimens at present available, to justify the erection of a separate species. It also seems better to ally the Colorado form with the American species than with the more remote European form, though a more thorough study may prove all to be but races of the same species.

Genus **Cinara** Curtis.*

Type, *Aphis pini* Linnaeus, (Curtis, Brit. Entom. Sectn., 576, 1835).

Characters.—Body usually 3 to 5 mm. long and robust, bearing moderate to long, erect hairs. Color.—Brown or black, usually with more or less of a pattern of white secretion. Antennæ shorter than the body, 6-jointed, with unguis of VI shorter than half of base. Rostrum lance-like. Cornicles mere rings nearly always on a conical and hairy base. First tarsal joint distinctly trapezoidal, longer than broad. Wings hyaline; radial sector straight, arising from lower distal angle of stigma; media faint, usually twice but sometimes once forked; hind wings with both media and cubitus. Living on bark of twigs and limbs of *Conifera*.

Genotype, *Cinara pini* (Linnaeus). (See below.)

**Cinara* Curtis is here used for the genus which has heretofore been designated by the writers as *Lachnus* Burmeister. *Lachnus* Burmeister is here used to replace *Pterochlorus* Rondani. The writers have been forced to make this change on learning of the fact that *Lachnus fasciatus* Burmeister is a synonym of *A. roboris* L. (Schumacher, Zoo. Anz. 1921 and 2). *A. roboris* was the first type set for *Lachnus* but was considered invalid on account of not being included by Burmeister in his original description of the genus. *A. roboris* is now validated and *Pterochlorus* is a synonym of *Lachnus*. *Cinara* Curtis was published the same year as *Lachnus* with *Aphis pini* Linnaeus designated as type. According to rule this designation is valid regardless of mistaken identification by Curtis. For fuller discussion on this question see paper by F. C. Hottes (Pr. Bio. Soc. Wash., Vol. 43, p. 185–8, 1930).

KEY TO SPECIES OF CINARA.

A. Cornicles not on distinct conical base. (Base very narrow if present and not raised). On *Pseudotsuga taxifolia.*
  B. Tibial hairs on hind tibiae* fine and numerous, especially on distal half of tibiae, very drooping. (Page 872) ..... **taxifoliae**
BB. Tibial hairs rather spine-like, hardly numerous, and rather erect.
  C. Distal one-third or more of hind tibiae dark to black in live specimens. (Page 865) ..... **pseudotsugae**
  CC. Only tips of hind tibiae black in live specimens. (Page 871) ..... **splendens**
AA. Cornicles on distinct conical base.
  B. Cornicle base bearing both long and short hairs. On *Pinus ponderosa.* (Page 870) ..... **solitaria**
BB. Cornicles bearing only one kind of hairs.
  C. Hairs on dorsum of abdomen of apterae minute, hardly exceeding .02 mm. in length and very sparse or absent.
    D. Vertex only slightly convex.
      E. Hairs on antennae shorter than one-half the diameter of joint, very drooping. On *Apinus flexilis.* (Page 853) ..... **flexilis**
    EE. Hairs on antennae one-half to as long as the diameter of joint, at angle of 45 degrees. On *Pinus edulis.* (Page 847) ..... **atra**
  DD. Vertex strongly convex. On *Pinus scopulorum.* (Page 854) ..... **glabra**
  CC. Hairs on dorsum of abdomen of apterae distinctly more than .03 mm. in length.
    D. Tibial hairs in apterae not longer than diameter of tibia.
      E. Hind tarsi hardly equalling one-tenth length of hind tibiae. On *Abies lasiocarpa.* (Page 850) ..... **curvipes**
    EE. Hind tarsi one-tenth of length of tibiae or more.
      F. Joint IV of antenna 1.5 or more times joint VI with unguis.
        G. Tibial hairs over .05 mm. On *Pinus edulis.* (Page 851) ... **edulis**
      GG. Tibial hairs not more than .05 mm.
        H. Tibial hairs stout and blunt. On *Picea parryana.* (Page 849) ..... **coloradensis**
      HH. Tibial hairs fine and pointed. On *Pinus ponderosa* var. *scopulorum.* (Page 868) ..... **schwarzii**
      FF. Joint IV of antennae not more than 1.25 times joint VI with unguis.
        G. Hairs on hind tibia very drooping, forming angle of 30 degrees or less. On *Pinus ponderosa* var. *scopulorum.* (Page 868), **schwarzii**
        GG. Hairs at angle of more than 30 degrees with tibia.
          H. Base of cornicles about .25 mm. in diameter. Color black. Without powder. On *Picea engelmanni.* (Page 857) . **hottesi**
        HH. Base of cornicles .30 mm. or over in diameter. Color brown. Powdery.
          I. Hairs rather sparse on outer margin of hind tibiae, even in alatae. Sensoria on joint III of alatae 5 to 7 in number.
            J. Joint III rarely more than .55 mm. in length. On *Pinus ponderosa* var. *scopulorum.* (Page 864) . **ponderosae**
          JJ. Joint III rarely less than .55 mm. in length. On *Pinus murrayana.*
            K. Tibial hairs about .08 mm., semispinelike. (Page 859) ..... **medispinosa**
          KK. Tibial hairs not over .05 mm., spine-like. On *Pinus contorta* var. *murrayana.* (Page 848) ..... **brevispinosa**
          II. Hairs numerous on tibiae, especially in alatae.
            J. Hairs on tibiae of apterae hardly one-half as long as diameter of tibiae. On *Apinus flexilis.* (Page 846) . **apini**

*"Tibial hairs," wherever herein mentioned, means hairs on outer side of middle of hind tibiae.

JJ. Hairs on tibiae of apterae over one-half as long as diameter of tibiae. On *Apinus flexilis*. (Page 847), **apini** var. **villosa**

DD. Tibial hairs on hind tibiae in apterae once but less than twice as long as diameter of tibiae.

E. Cornicle bases small, not over .20 mm. in diameter.

F. Hind tibiae in apterae longer than one-half body. Rostrum much longer than body. On *Pinus murrayana*, on cones. (Page 862) ..... **oregonensis**

FF. Hind tibiae in apterae not longer than one-half body. Rostrum much longer than body.

F′. On *Sabina scopulorum*. (Page 866) ..... **pulverulens**

FF′. On *Picea parrayana*. (Page 854) ..... **fornacula**

EE. Cornicle base large, over .25 mm. in diameter.

F. Tibial hairs at angle not exceeding 60 degrees.

G. Hind tibiae fully .66 length of body. On *Pinus murrayana*. (Page 860) ..... **murrayanae**

GG. Hind tibiae less than .66 length of body.

H. Body in apterae not less than 4 mm. in length. (Page 860), **lasiocarpae**

HH. Body in apterae not over 4 mm.

I. Antennae of alate viviparae with 3–5 sensoria on joint III. Mediae twice branched. On *Picea parryana*. (Page 863) ..... **palmerae**

II. Antennae of alate viviparae with one sensorium on joint III. Mediae once branched. On *Juniperus sibirica*. (Page 858) ..... **juniperensis**

FF. Tibial hairs at an angle exceeding 60 degrees.

G. Apterous viviparae, light or amber brown, with powdery markings. Males alate.

H. Tibial hairs not numerous. On *Pinus edulis*. (Page 873), **terminalis**

HH. Tibial hairs numerous.

I. Powdery markings distinct. Mediae twice branched. On *Picea parryana*. (Page 855) ..... **glehna**

II. Powdery markings indistinct. Media one branched. On *Picea engelmanni* (Page 852) ..... **engelmaniensis**

GG. Apterous viviparae without powder. Males apterous. On *Picea engelmanni* (Page 874) ..... **vandykei**

DDD. Tibial hairs on hind tibiae of apterae twice or more times as long as diameter of tibiae.

E. Cornicle base small, .16 to .20 mm. in diameter. On *Abies lasiocarpa*. (Page 861) ..... **occidentalis**

EE. Cornicle base large, .30 mm. or more in diameter.

G. Joint III of antenna exceeding sum of joints IV and V, hairs of hind tibiae, .17 to .25 mm. in length. On *Sabina scopulorum*. (Page 867) ..... **sabinae**

GG. Joint III of antenna shorter than the sum of joints IV and V, hairs of hind tibiae .14 to .17 mm. long. On *Juniperus sibirica*. (Page 869) ..... **sibiricae**

[Genotype **Cinara pini** (Linnaeus).]

Linnaeus, Edition 10, Systema Naturae, p. 453, 1758. *Aphis*.

Color.—In both alate and apterous viviparæ, reddish-brown with numerous dark specks, a pair of larger ones posterior to cornicles; with pattern of white pulverulence; legs yellowish-red to dusky; cornicles dark.

Measurements.—Apterous summer vivipara.—Body 3.5 to 4 mm.; antennæ, hardly as long as head and thorax; joint III longest, about

equal to IV + V, IV longer than V, (shorter in photograph); VI equal to three-quarters of V; rostrum, attaining to or past third coxæ. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria round, and small, 7 to 9 in a row along almost entire length of III in alate viviparæ. Hairs long and numerous on all parts; on antennæ, nearly or quite twice as long as diameter of joints. Rostrum lance-like. [Data after Theobald (Aph. Gr. Br., Vol. 3, p. 145, 1929).]

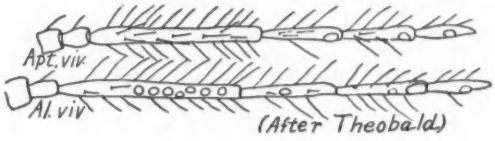

FIG. 14. *Cinara pini.*

Host.—On *Pinus sylvestris.** Not known in the state, probably on account of scarcity of the host plant.

Cinara apini (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 31, 1924. *Lachnus.*

Color.—In all forms.—Dark brown; mottled with powder; legs and antennæ yellowish to dusky.

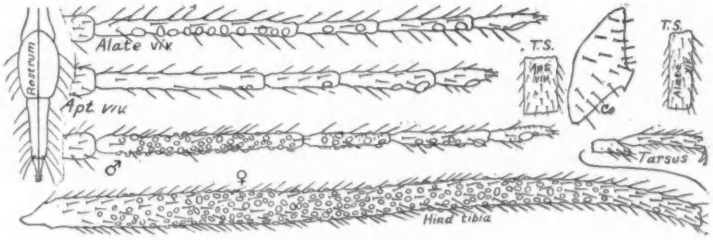

Fig. 15. *Cinara apini.*

Measurements.—Apterous summer vivipara.—Body 3.25 to 4 mm.; hind tibiæ 2.5 to 3 mm.; hind tarsi first joint .06 on outer margin, .12 mm. on inner margin; second joint .26 mm.; antennæ 1.25 mm.; joint III .42 to .52 mm.; IV .16 to .23 mm.; V .22 to .26 mm.; VI .11 to .13 + .03 to .05 mm.; cornicle base .35 to .40 mm. in diameter. Alate vivipara.—Same as aptera. Unguis rather heavy and blunt conical.

Structural Characters.—Secondary sensoria round, convex, 8 to 11 on III, 2 on IV, and 1 on V in alate viviparæ; in apteræ 0 to 1 on III,

*Record on *Pinus scopulorum* in Colorado by Cowen (Gillette and Baker, "Hemiptera of Colorado," Agr. Exp. Sta. Bul. 31, 1895) is doubtless in error.

1 to 2 on IV, and 1 on V. Rostrum attaining at least middle of abdomen. Hairs tending to be spine-like, moderately numerous; on body .05 to .07 mm. long; on cornicles slightly longer; on hind tibiæ set at angle of 30 to 45 degrees, .04 mm. long, in apteræ hardly as long as half diameter of tibiæ; in alatæ .06 to .07 mm., fully as long as diameter of tibiæ. Mediæ faint and twice forked. Males alate.

Collections.—On *Apinus flexilis* on bark of twigs and small branches; in large colonies. Quite sluggish and slow to escape. Recorded generally where the host plant occurs in the state; near Estes Park, Chambers Lake and Cherokee Park; apterous summer viviparæ, July 4 to Oct. 4; alate viviparæ, July 7 to Sept. 27; sexuales, Sept. 2 to Oct. 5; 9 collections, very common.

Types in U. S. Nat. Mus., Cat. No. 41964; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara apini var. **villosa** n. var.

Similar to *apini* excepting that the tibial hairs are longer, in the apteræ .06 mm., length over half diameter of tibia, and in the alatæ .11 mm., once and one-half times diameter of tibia.

FIG. 16. *Cinara apini* var. *villosa.*

Taken in same localities and on same host as given above for *apini* but not observed mixed in the same colonies or on the same tree. This is the long-haired form referred to in the original description of *apini.* Fundatrices, June 30 to July 8; apterous summer viviparæ, July 12 to Aug. 27; alate viviparæ, July 26 to Aug. 9; 12 collections; common.

Types in U. S. Nat. Mus. Cat. No. 42811; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara atra (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 37, 1924. *Lachnus.*

Color.—Shining black in all forms; no powder on dorsum; legs and antennæ yellowish to dusky.

Measurements.—Apterous summer vivipara.—Body 2 to 3 mm.; hind tibiæ 1.3 to 1.8 mm.; hind tarsi, first joint .05 mm. on outer edge, .08 to .10 mm. on inner edge; second joint .25 to .28 mm.; antennæ 1.05 mm.; joint III .32 to .38 mm.; IV .15 to .17 mm.; V .20 mm.; VI .10 + .03 to .04 mm.; cornicle base .25 to .30 mm. in diameter.

Alate vivipara.—Same as aptera. Hairs drooping, set at angle of 30 degrees, medium in texture and hardly numerous, on outer side of hind tibiæ, in alatæ attaining .06 to .09 mm.; length equalling 1 to 1.5 times diameter of tibiæ; in apteræ, hairs on tibiæ .04 to .06 mm. long, shorter than diameter of tibia; on body and cornicles .01 to .02 mm. long. Rostrum about same length as body.

Structural Characters.—Secondary sensoria absent in apteræ or occasionally 1 on IV and V; in alate viviparæ 4 to 7 on III, 1 to 2 on IV, and 1 on V. Unguis broadly conical. Mediæ variable, either once or twice forked. Males apterous.

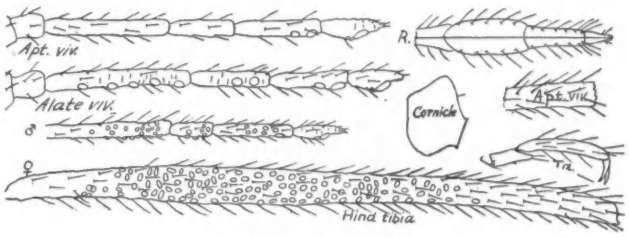

FIG. 17. *Cinara atra.*

Collections.—On *Pinus edulis*, on bark of limbs in small colonies, with ants. Recorded from the state in Owl Canon in Larimer County; apterous summer viviparæ, Aug. 6 to Oct. 19; alate viviparæ, Aug. 6; oviparæ, Oct. 27 to Nov. 6; males, Oct. 6; 6 collections, fairly common.

Types in U. S. Nat. Mus., Cat. No. 41966; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara brevispinosa (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 27, 1924. *Lachnus.*

Color.—In all forms.—Brown; mottled with dusky and with slight powder in apteræ medially and laterally; alatæ without powder; legs and antennæ mostly dusky.

Measurements.—Apterous summer vivipara.—Body 3 mm.; hind tibiæ 2 to 2.7 mm.; first joint of hind tarsi .05 mm. on outer side, .10 mm. on inner side; second joint .25 mm.; antennæ 1.50 mm.; joint III .47 to .64 mm.; IV .20 to .26 mm.; V .20 to .30 mm.; VI .12 + .03 to .05 mm. Alate vivipara.—Same as aptera or slightly smaller.

Structural Characters.—Secondary sensoria in alate viviparæ, 5 to 8 on III, 1 to 2 on IV, and 1 on V; in apteræ 1 to 2 on III, 1 on IV, and 1 on V. Unguis heavy-conical. Rostrum attaining middle of abdomen. Mediæ twice branched. Hairs blunt and stout, drooping, short, numerous, on outer side of hind tibiæ, .05 mm. long, shorter than diameter of tibiæ in alate viviparæ; .04 mm. and about one-half diameter

in apterous viviparæ. Cornicles conspicuous, .30 to .45 mm. in diameter at base. Males alate.

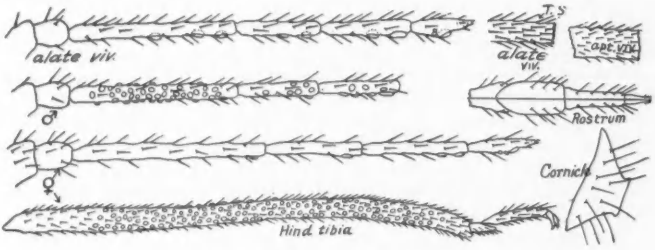

FIG. 18. *Cinara brevispinosa.*

Collections.—On *Pinus contorta* var. *murrayana*, on bark of twigs and small branches, in colonies. Recorded from the state in Rocky Mountain National Park, Chamber's Lake, Pingree Park, and Bellvue foothills; fundatrices, May 23 to June 13; apterous summer viviparæ, June 17 to Aug. 24; alate viviparæ, June 30 to July 17; sexuales, Aug. 21 to Oct. 2; 14 collections; rather common.

Types in U. S. Nat. Mus., Cat. No. 41962; paratypes in collection of Colo. Agr. Exp. Sta.

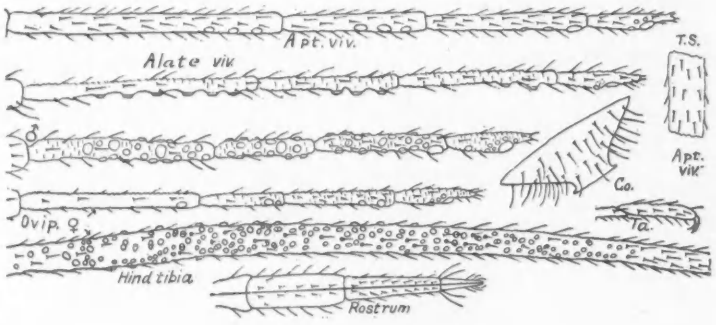

FIG. 19. *Cinara coloradensis*

Cinara coloradensis (Gillette).

Gillette, Ann. Ent. Soc. of Amer., Vol. 10, No. 2, p. 133, 1917. *Lachnus.*

Color.—In all forms.—Brownish-black, in apteræ lighter anteriorly, with little or no pulverulence, excepting tip of abdomen in oviparæ; legs brown to black.

Measurements.—Apterous summer vivipara.—Body 4 to 4.3 mm.; hind tibiæ 3 mm.; first joint of hind tarsi .07 mm. on inner side, .14 mm. on outer side; second joint .33 mm.; antennæ 1.6 to 2 mm.; joint III .40 to .75 mm.; IV .20 to .35 mm.; V .24 to .45 mm.; VI .12 to .15 + .04 to .06 mm.; cornicles .20 to .30 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria tuberculate in alate viviparæ 7 to 8 on III, 1 to 3 on IV, and 2 on V at distal end of joints; in apteræ, 1 to 5 on III, 1 to 2 on IV, and 0 on V. Rostrum attaining middle of abdomen. Mediæ rather faint and twice forked. Hairs on hind tibiæ short, .03 to .05 mm., usually blunt, stout, drooping, length equalling one-half diameter of tibiæ in alatæ, one-third in apteræ, at angle not more than 30 degrees, moderately numerous; hairs on body pointed, slightly longer and erect. Males alate.

Collections.—On *Picea parryana* and *Engelmannii*, on bark of twigs and small branches; in colonies. Recorded from the state in vicinity of Loveland, Rocky Mountain National Park, (alt. 8000), Grand Junction (Alexander Lakes, 10,000) and Fort Collins; fundatrices, Apr. 20; apterous summer viviparæ, June 6 to Sept. 1; alate viviparæ, May 12 to Sept. 19; sexuales, Sept. 1 to Nov. 12; 14 collections; fairly common, especially in parks.

Types in U. S. Nat. Mus., Cat. No. 41941; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species is very closely allied to *C. curvipes* (Patch), differing in smaller size, smaller number and more distal location of secondary sensoria, hairs on hind tibiæ more generally blunt, and hind tarsi more than one-tenth of tibiæ, as well as the different genus of host plant.

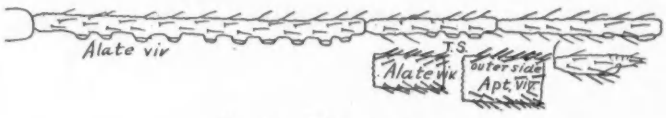

FIG. 20. *Cinara curvipes.*

Cinara curvipes (Patch).

Patch, Me. Agr. Exp. Sta. Bul. 202, p. 161, 1912. *Lachnus.*

Color.—In all forms.—Brownish-black, with very little or no pulverulence, except tip of abdomen of oviparæ; antennæ pale; legs brown to black.

Measurements.—Apterous summer vivipara.—Body 5 mm. long; hind tibiæ 3.5 to 4.6 mm.; first joint of hind tarsus .06 mm. on outer side, .15 mm. on inner side; second joint .38 mm.; antennæ 2 to 2.2 mm.;

joint III .85 to .95 mm.; IV .26 to .36 mm.; V .30 to .45 mm.; VI .18 + .06 mm.; cornicles about .45 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria tuberculate in alate viviparæ 8 to 12 on III, 3 on IV, 1 on V; in apteræ 1 to 3 on III, 1 on IV, and 1 on V. Unguis conical and stout. Hind tibiæ distinctly curved. Hairs on hind tibiæ drooping, rather stout, often blunt, numerous, .04 to .05 mm. long, not longer than half diameter of tibiæ*; hairs on body pointed, .06 to .08 mm. and erect. Rostrum attaining middle of abdomen. Mediæ faint and twice forked. Males alate.

Collections.—On *Abies lasiocarpa*, on bark. Recorded in the state at Eldora, Ouray, and Rocky Mountain National Park; fundatrices, June 13 and 24; apterous summer viviparæ, June 24 to Aug. 28; alate viviparæ, July 8 to Aug. 28; oviparæ, Aug. 28; 8 collections; rare.

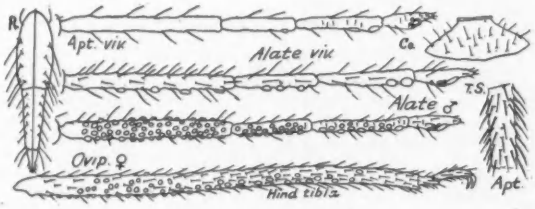

FIG. 21. *Cinara edulis.*

Cinara edulis (Wilson).

Wilson, The Can. Ent., Vol. 51, p. 41, 1919. *Lachnus.*

Color.—Dull black with fine median line and intersegmental patches powdery; legs mostly blackish, light portions orange-yellow.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm. long; hind tibiæ 2.5 to 3 mm.; first joint of hind tarsi .06 mm. on outer margin, .11 mm. on inner margin; second joint .26 mm.; antennæ 1.3 to 1.5 mm.; joint III .42 to .55 mm.; IV .22 to .30 mm.; V .20 to .30 mm.; VI .08 to .11 + .05 mm.; cornicles .35 to .50 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Hairs on hind tibiæ fine, pointed, at angle of 45 degrees, numerous, .08 mm. long, hardly as long as diameter of tibia; on body and cornicles about the same or slightly shorter. Secondary sensoria somewhat tuberculate, arranged in single row along distal two-thirds of joints, 3 to 6 on III, 2 to 3 on IV and 1 on V in alate

*In the same collections appear individuals, especially apterae with pointed hairs as on body, but not as long as diameter of tibiae. Perhaps the blunt hairs are broken, but this would be very strange considering the uniformity of the condition in certain individuals.

viviparæ; in apterous viviparæ 1, rarely 2 to 3 on III, 1 on IV and 1 on V. Unguis short and thick, conical. Rostrum attaining cornicles. Males alate.

Collections.—On *Pinus edulis*, bark of limbs and older twigs, in large colonies. Recorded in the state from Owl Canon in Larimer County, and Salida, Trinidad and Walsenburg; fundatrices, May 24 to June 8; apterous viviparæ, May 27 to Sept. 25; alate viviparæ, May 27 to Sept. 18; sexuales, Oct. 18 to 28; 12 collections; common.

Taxonomy.—This species is structurally very close to *C. schwarzii*, but differs slightly in color of legs and body markings, length of hairs, size of cornicles and food plant. Since it is the rule for this genus to be specific as to food plant, it seems best to count the species distinct until biological tests are applied to settle the identity.

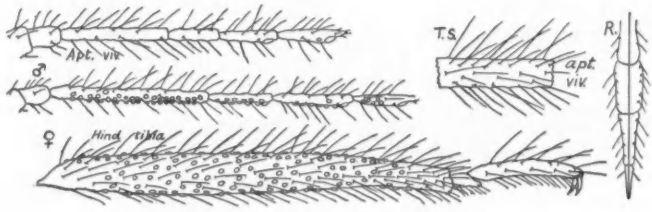

FIG. 22. *Cinara engelmaniensis.*

Cinara engelmanniensis (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 18, p. 526, 1925. *Lachnus.*

Color.—In viviparæ and oviparæ.—Light cinnamon-brown to tan or pinkish-buff; with a pair of longitudinal rows of green or black spots; in alate male, abdomen, apple green; pulverulence evident only on intersegmental lines; legs mostly pale especially in apteræ; cornicles brownish to dusky.

Measurements.—Apterous summer vivipara.—Body 3 mm. by 2 mm.; hind tibiæ 1.2 mm.; first joint of hind tarsi .05 mm. on outer edge, .09 on inner edge; second joint .35 mm.; antennæ, 1 mm.; joint III, .24 to .33 mm.; IV .10 to .16 mm.; V .13 to .18 + .03 mm.; cornicles .30 mm. in diameter at base.

Structural Characters.—Secondary sensoria absent in apteræ. Unguis short and stout, conical. Hairs on hind tibiæ rather fine, erect, numerous, .15 mm. long, 1.5 times as long as diameter of tibiæ; on body, .10 mm. long. Rostrum attaining first and second segments of abdomen. Mediæ once forked. Males alate.

Collections.—On *Picea engelmanni*, on bark of twigs in small colonies or scattered. Recorded in the state near Laramie-Poudre Tunnel, near Long's Peak, Pingree Park, and Black Mesa; apterous summer viviparæ, July 9 to Aug. 20; alate viviparæ not taken; oviparæ, Sept. 9 to Oct. 21; males, Sept. 3; 5 collections; rather rare.

Types in U. S. Nat. Mus., Cat. No. 41943; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—Resembles *C. braggii*, *glehna* and *farinosa*, but differs mainly in having very slight powder while the latter are heavily powdered to woolly, and in the once forked media which is twice forked in the others. Also the hind tibiæ are dusky only at tip, while many of these other species are dark for at least one-half.

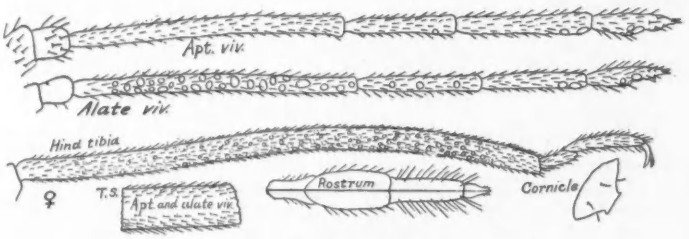

FIG. 23. *Cinara flexilis.*

Cinara flexilis (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 30, 1924. *Lachnus.*

Color.—In all forms taken.—Brownish-black, greenish on thorax in younger examples; legs dusky orange to blackish.

Measurements.—Apterous summer vivipara.—Body 4 to 5 by 2 mm.; hind tibiæ 3.25 mm.; first joint of hind tarsi .16 mm. on outer side, .23 mm. on inner side; second joint .45 mm.; antennæ 2 mm.; joint III .78 to .90 mm.; IV .32 to .39 mm.; V .38 to .42 mm.; VI .18 + .08 mm.; cornicles .15 to .20 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Hairs on body .01 to .03 mm. long and sparse in some places, in others .04 to .08 mm. and numerous; on hind tibiæ pointed, decumbent, very numerous, .03 to .04 mm. long, not longer than one-third of diameter of tibiæ in aptera, one-third to one-half in alate viviparæ. Unguis heavy, cylindrical with conical tip. Secondary sensoria flat and irregular in size, scattered along almost entire length of joint, 17 to 25 on III, 3 on IV, and 1 on V in alate viviparæ, in apteræ 0 on III, 0 to 2 on IV and 1 on V. Rostrum rather

stout, attaining middle of abdomen. Mediæ faint, twice forked (only 2 alatæ collected). Very nervous and quick to escape. Males not taken.

Collections.—On *Apinus flexilis*, on bark of twigs and small branches; rather scattered, not in colonies. Recorded in the state near Estes Park; apterous summer viviparæ, July 22 to Aug. 18; alate viviparæ, July 22; oviparæ, Sept. 18 and 21; 4 collections; rare.

Types in U. S. Nat. Mus., Cat. No. 41963; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara fornacula Hottes.

Hottes, Pr. Bio. Soc. Wash., Vol. 43, p. 186, 1930.

Color.—In apterous summer vivipara.—Light green; brownish on head, with brown spots on body; slightly pulverulent; legs mostly yellowish-brown.

Measurements.—Apterous summer vivipara.—Body 3 mm.; hind tibiæ 1.40 mm.; first joint of hind tarsi, .05 mm. on outer side, .11 mm. on inner side; second joint .45 mm.; antennæ 1.05 mm.; joint III .35 mm.; IV .15 mm.; V .22 mm.; VI .17 + .04 mm.; cornicles .14 mm. in diameter at base.

Structural Characters.—Hairs on outer side of hind tibiæ spine-like, set at angle of 50 to 80 degrees, .08 to .11 mm. long, as long or slightly longer than the diameter of the tibia; on antennæ, slightly finer and shorter and about twice as long as diameter of joint; on body and cornicles, about same as on antennæ. Secondary sensoria absent. Cornicles with mammiform base, bearing but one kind of hairs. Rostrum lance-like, attaining second abdominal segment.

Collections.—On *Picea parrayana*, on twigs, solitary. Very active. Recorded from the state at Cameron Pass; apterous summer vivipara, Aug. 26; no other form taken; one collection; apparently very rare or exceedingly difficult to find.

Described from the single specimen taken by F. C. Hottes in northern Colorado and referred to by him in his original description.

Cinara glabra (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 35, 1924. *Lachnus.*

Color.—In all forms.—Dusky olive-green to olive-brown to black; without powder on dorsum; shining on head, remainder of dorsum wrinkled; legs mostly dusky, lighter parts orange-brown; wings slightly smoky, stigma and costal cell quite brownish.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3 mm.; hind tibiæ 1.5 to 1.75 mm.; first joint of hind tarsi .06 mm. on outer

side, .10 mm. on inner side; second joint .26 mm.; antennæ 1.1 mm.; joint III .40 to .48 mm.; IV .14 to .24 mm.; V .18 to .20 mm.; VI .14 + .07 mm.; cornicles .15 to .20 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Hairs fairly numerous on tibiæ at angle of 45 degrees to nearly erect, .03 mm. to .05 mm. long, about as long as half of diameter of tibiæ in apterous viviparæ, nearly equal in alatæ; on dorsum sparse, minute, .01 mm. to .02 mm. long. Unguis stout, cylindrical with conical tip. Secondary sensoria flat, irregular in size located distally on joint, on III only, 4 in number in alate viviparæ; absent in apteræ. Rostrum slender, nearly as long as body. Vertex strongly convex, appearing rather pointed. Femora not thickened. Ocular tubercles plainly evident. Mediæ faint and twice forked. Males alate.

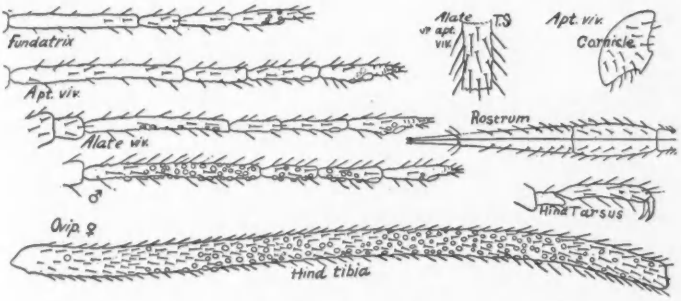

FIG. 24. *Cinara glabra.*

Collections.—On *Pinus scopulorum*, on twigs at bases of needles; solitary or in small colonies. Recorded in the state near Estes Park, Big Thompson Canon, Log Cabin, foothills about Fort Collins, Bellvue and Denver; fundatrices, May 11; apterous summer viviparæ, May 25 to Aug. 21; alate viviparæ rare, June 25 to Aug. 20; sexuales, Sept. 10 to Oct. 22; 17 collections; rather common.

Types in U. S. Nat. Mus., No. 41965; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara glehna (Essig).

Essig, Jour. Ent. & Zool., Claremont, Cal., Vol. 7, p. 180, 1916. *Lachnus.*
Syn. Gillette, Ann. Ent. Soc. of Amer., Vol. 10, No. 2, p. 138, 1917. *Lachnus braggii.*

Color.—In all forms.—Yellowish with dark brown areas and almost entirely covered with white powder; legs and antennæ pale.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm.; hind tibiæ 1.3 to 1.6 mm.; first joint of hind tarsi .06 mm. on outer margin, .10 mm. on inner margin; second joint .32 mm.; antennæ 1 to 1.17 mm.; joint III .46 to .56 mm.; IV .18 to .21 mm.; V .18 to .28 mm.; VI .14 + .03 mm.; diameter of cornicles at base .20 to .30 mm., sometimes surrounding area to .40 or .50 mm. darkened but covered with powder in life to diameter of .14 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria round, slightly convex, 1 to 4 on III, 1 on IV, and 2 on V in alatæ; in apteræ 0 on III, 1 or 2 on IV, and 2 on V, located on distal ends of joints. Hairs rather fine, erect, .15 to .17 mm. long, 1.5 as long as diameter of tibia in apteræ, 2 to 3 times in alatæ. Rostrum attaining third coxæ. Males alate.

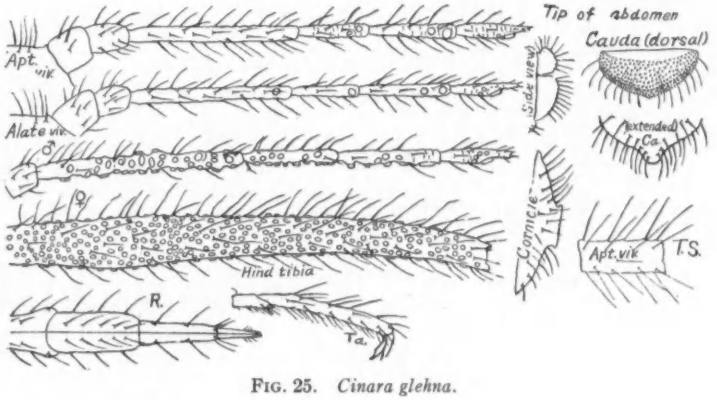

FIG. 25. *Cinara glehna.*

Collections.—On *Picea parryana* and *glehni*, on bark of twigs and small branches in colonies. Recorded in the state in vicinity of Boulder, Denver, and Fort Collins, but never in the hills; fundatrices, April 13 to 21; apterous summer viviparæ, April 22 to June 22; alate viviparæ, May 11 to June 22; sexuales, Oct. 23 to Nov. 13; 21 collections; rather common in parks.

Types of *braggii* in U. S. Nat. Mus., Cat. No. 41940; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—Resembles very much *C. farinosa* Cholod., and may be a synonym, but mediæ in all our examples are twice forked, while in *farinosa*, they are once forked according to P. Van der Goot's description, (Beit. z. Kenntid, Holl. Blattlause, p. 389, 1915). The authors have not had access to Cholodkovsky's description (Rev. Sci. Nat. St. Petersburg, No. 8, 1891), so are unable to definitely decide the question.

Cinara hottesi (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 22, 1924. *Lachnus.*

Color.—In all forms.—Bluish-black, with no pulverulence; legs conspicuously yellow.

Measurements.—Apterous vivipara.—Body 2.8 to 3.5 mm. long, pyriform; hind tibiæ 1.7 to 2.5 mm.; first joint of hind tarsi .06 mm. on outer margin, 11 mm. on inner margin; second joint .28 mm.; antennæ 1.55 to 1.6 mm.; joint III .55 to .60 mm.; IV .25 mm.; V .25 to .28 mm.; VI .11 to .16 + .05 to .07 mm.; cornicles .55 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate vivipara convex, located distally, on III 3 to 5, on IV 0 to 1, on V 0 to 1; in apterous vivipara 0 to 1 on III, 2 to 3 on IV, 1 to 2 on V. Unguis conical, rather acute. Hairs on hind tibiæ numerous, set at angle of 45 degrees, .08 mm. long, slightly longer than diameter of tibiæ in apteræ, 1.5 times in alatæ; on body and antennæ, .10 mm. long. Rostrum about as long as the body. Mediæ twice forked and faint.

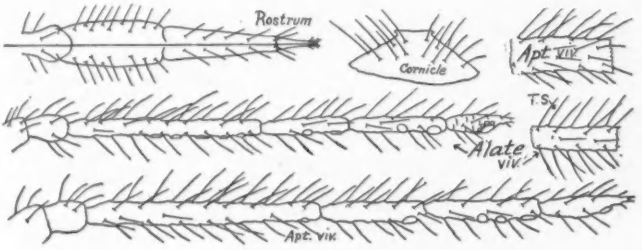

FIG. 26. *Cinara hottesi.*

Collections.—On *Picea engelmannii* on bark of young limbs. Recorded in the state in Rocky Mountain National Park; fundatrices, June 13; apterous summer viviparæ (reared in insectary from fundatrices above-mentioned), July 8; alate vivipara (reared with apteræ above mentioned) July 17; sexuales not taken; only one collection in nature; rare.

Types in U. S. Nat. Mus., Cat. No. 41959; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species seems to approach *C. curvipes* (Patch) but differs in longer hairs, fewer sensoria and light yellow legs.

Cinara juniperensis (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 18, p. 526, 1925. *Lachnus.*

Color.—In all forms taken.—Light greenish-brown to dark brown; with slight pulverulence, especially on intersegmental lines and lateral areas, tip of abdomen of oviparа heavily covered; cornicles black; legs considerably black with yellowish proximally.

Measurements.—Alate vivipara.—Body 4 mm. long; hind tibiæ 3.2 mm.; first joint of hind tarsi .05 mm. on outer edge, .12 mm. on inner edge; second joint .44 mm.; antennæ 1.75 mm.; joint III .56 to .60 mm.; IV .27 mm.; V .30 to .34 mm.; VI, .23 + .03 mm.; cornicles about .40 mm. in diameter at base.

Structural Characters.—Secondary sensoria convex but not tuberculate, in alate viviparæ, 1 on III, 1 on IV, and 1 on V; oviparæ same as alate viviparæ. Unguis short, conical. Hairs on outer side of hind tibiæ pointed, set at angle slightly exceeding 45 degrees, numerous, .13 mm. long, 1.5 times as long as diameter of tibia in alatæ and oviparæ. Rostrum broadly acute, attaining middle of abdomen. Mediæ once branched (only 2 alatæ taken).

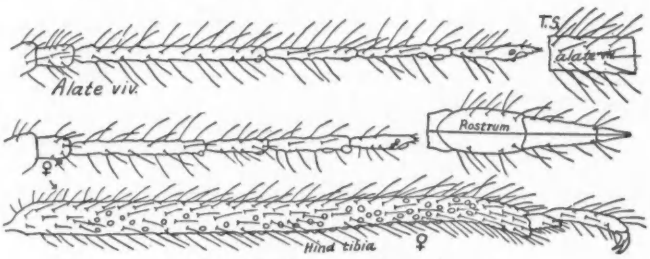

FIG. 27. *Cinara juniperensis.*

Collections.—On *Juniperus sibirica* on bark of tender twigs. Recorded in the state in Pingree Park and Rocky Mountain National Park; alate viviparæ, Aug. 20; oviparæ, Aug. 24; 2 collections; very rare.

Types in U. S. Nat. Mus., Cat. No. 41944; paratypes in collection of Colo. Agr. Exp. Sta.

Cinara lasiocarpae (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 23, p. 543, 1930. *Lachnus.*

Color.—Apterous viviparæ.—Reddish to dark brown, mottled with broken pattern of white pulverulence; legs almost entirely black.

Measurements.—Apterous summer vivipara.—Body 4 to 5 mm. long, robust; hind tibiæ 3.5 mm.; first joint of hind tarsi .04 mm. on outer side, .12 mm. on inner side; second joint .42 to .50 mm.; antennæ

2 mm.; joint III .80 to .90 mm.; IV .34 to .44 mm.; V .40 to .45 mm.; VI .21 to .25 + .04 to .07 mm.; cornicles .30 to .50 mm. in diameter at base.

Structural Characters.—Secondary sensoria convex, slightly tuberculate, 0 on III, 2 to 3 on IV; 2 to 3 on V in apteræ. Unguis conical, acute, slender. Hairs pointed and spine-like, set at angle of 50 degrees, .14 to .16 mm. long, longer than diameter of tibiæ. Rostrum attaining cornicles.

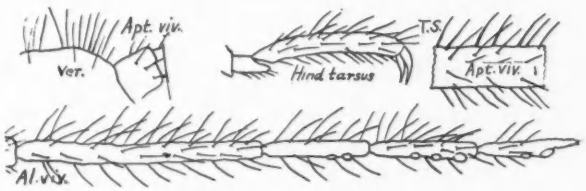

FIG. 28. *Cinara lasiocarpae.*

Collections.—On *Abies lasiocarpa*, on bark of twigs. Recorded in the state in Rocky Mountain National Park along Fall River, Black Mesa, and Rabbit Ears Pass; fundatrices, July 7 and 22 (altitude 9000 and 10,000 ft.); apterous summer viviparæ, July 7 to Aug. 12; alatae and sexuales not taken; 5 collections; rare.

Types in U. S. Nat. Mus., Cat. No. 42082; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species appears to be very closely allied to *Cinara grossa* (Kaltenbach) but differs from examples determined *grossa* and kindly sent by Cholodkovsky, in longer antennal joints, especially joint IV, and longer tarsi. (See original description of *lasiocarpae*).

Cinara medispinosa (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 22, p. 30, 1929. *Lachnus.*
Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 23, 1924. *Lachnus similis.*

Color.—In all forms.—Yellowish-brown to dark metallic brown with slight pulverulence on median line and lateral areas, also on tip of abdomen in oviparæ; marked with broken black dashes on dorsum, medially and laterally, more pronounced anteriorly; legs mostly black.

Measurements.—Apterous summer vivipara.—Body 3 mm.; hind tibiæ 2.15 to 2.7 mm.; first joint of hind tarsi .05 mm. on outer side, .11 mm. on inner side; second joint .28 mm.; antennæ 1.5 mm.; joint III .53 to .68 mm.; IV .20 to .27 mm.; V .20 to .30 mm.; VI .10 to .13 + .03

to .05 mm.; cornicles .55 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate viviparæ 5 to 8 on III, 1 to 2 on IV and 1 on V.; in apteræ 1 to 2 on III, 1 on IV and 1 on V. Unguis stout, conical. Hairs on hind tibiæ, semi-spine-like to fine, set at angle of 45 degrees, numerous, .07 to .08 mm. long, shorter than diameter of tibiæ in apteræ, slightly longer in alatæ; hairs on body and antenna about the same as on tibiæ; on cornicles .10 mm. Rostrum attaining middle of abdomen. Mediæ twice forked. Males alate.

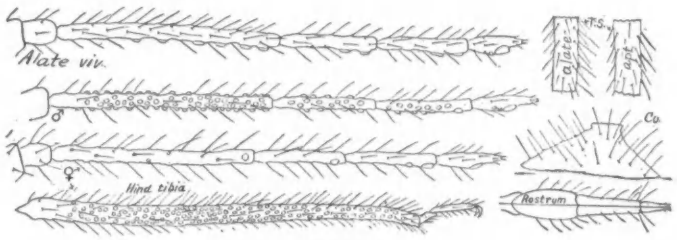

FIG. 29. *Cinara medispinosa.*

Collections.—On *Pinus contorta* var. *murrayana* on bark of tender twigs and young branches. Recorded in the state in foothills near Bellvue, Laramie-Poudre Tunnel, Pingree Park, and Tolland; fundatrices, May 9 to June 8; apterous summer viviparæ, May 31 to Sept. 16; alate viviparæ, May 31 to June 17; sexuales, Oct. 2 to Oct. 19; 14 collections; rather common.

Types in U. S. Nat. Mus., Cat. No. 41961; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species differs from *C. brevispinosa* chiefly in length of hairs, slightly larger measurements and larger number of sensoria. The two forms grade very close together but evidence from breeding observations seems to indicate separate identity. (See original description p. 39.)

Cinara murrayanae (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 26, 1924. *Lachnus.*

Characters.—Color same as *C. medispinosa* and measurements differing only in slightly larger size. The only distinguishing character is the heavier, more erect, and longer hairs. Hairs on hind tibiæ set at angle of 45 degrees to nearly erect, .10 to .15 mm. long, somewhat

longer than diameter of tibiæ in apteræ, and almost twice in the alatæ; on antennæ about .10 to .11 mm. long. Other characters as in *medispinosa* described above.

Collections.—On *Pinus contorta*, on bark of twigs and small branches. Recorded in the state in foothills above Bellvue; fundatrices, May 20; apterous summer viviparæ, June 3 to June 12; alate viviparæ, June 3; sexuales, Oct. 2 to 9; 5 collections; rare.

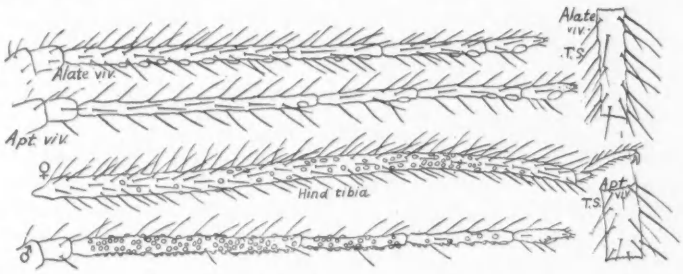

FIG. 30. *Cinara murrayanae.*

Types in U. S. Nat. Mus., Cat. No. 41960; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species is very close to *C. medispinosa* described above. The only apparent difference is in the longer, stouter and more erect hairs. Breeding experiments lend support to the separate identity of the two forms. (See original description and p. 29 of same article.)

Cinara occidentalis (Davidson).

Davidson, Jour. Econ. Ent., II, p. 300, 1909. *Lachnus.*

Color.—In all forms.—Yellowish olive-green to greenish-brown, with a pair of longitudinal rows of dark areas, which tend to vanish on middle of abdomen; covered with flocculent pulverulence; cornicles, antennæ, legs, stigma and subcostal vein, pale.

Measurements.—Apterous summer vivipara.—Body 2 to 3 mm.; hind tibiæ 1.1 to 1.3 mm.; first joint of hind tarsi .02 mm. on outer side, .06 mm. on inner side; second joint .32 mm.; antennæ 1 to 1.1 mm.; joint III .30 to .35 mm.; IV .12 to .17 mm.; V .15 to .20 mm.; VI .13 to .15 + .03 to .04 mm.; cornicles .15 to .17 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria small, on III, 1 to 3; on IV 2 to 3; on V 0; absent in apteræ. Unguis slender, conical. Hairs on hind tibiæ fine, nearly or quite erect, fairly numerous, .18 to .22

mm. long, 3 times the diameter of the tibia in alatæ, 2 to 3 times in apteræ; on body and antennæ .10 mm. long. Rostrum attaining second abdominal segment. Mediæ very faint and usually twice forked but occasionally once forked. Males alate.

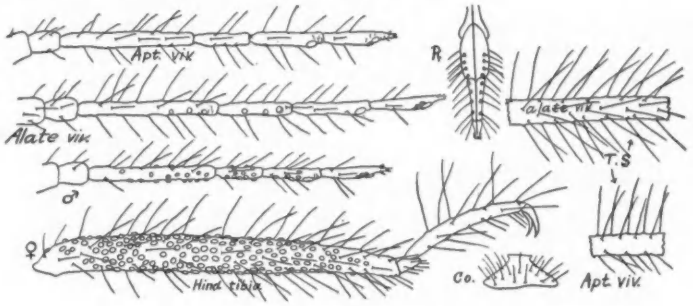

FIG. 31. *Cinara occidentalis.*

Collections.—On *Abies lasiocarpa*, on bark of twigs, eggs laid on needles. Recorded in the state near Laramie-Poudre Tunnel, Rocky Mountain National Park, and foot of Long's Peak; fundatrices, May 20 to July 7; apterous summer viviparæ, June 14 to Sept. 16; alate viviparæ, June 10 to Sept. 16; sexuales, Sept. 16 to Oct. 21; 14 collections; common.

Cinara oregonensis (Wilson).

Wilson, Trans. Amer. Ent. Soc. XLI, p. 103, 1915. *Lachnus.*

Color.—In all forms.—Brick-red, shining; slightly pulverulent on thorax of alatæ, young, and sexuales, especially tip of abdomen of

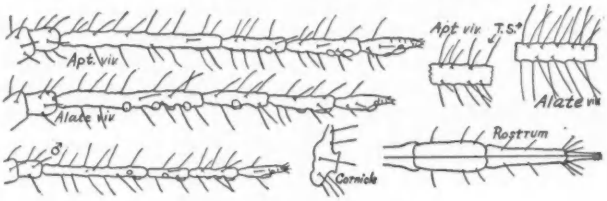

FIG. 32. *Cinara oregonensis.*

oviparæ; legs and antennæ yellow-brown to dusky; cornicles somewhat dusky.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3 mm. long; hind tibiæ 1.6 to 2 mm.; first joint of hind tarsi .04 mm. on outer

side, .08 mm. on inner side; second joint .27 to .30 mm.; antennæ .80 to 1 mm.; joint III .30 to .40 mm.; IV .10 to .16 mm.; V .12 to .19 mm.; VI .10 to .13 + .04 mm.; cornicles .10 to .15 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria large, convex, slightly tuberculate, 2 to 6 on III, 0 to 2 on IV; 0 to 1 on V in alate viviparæ, in apteræ 0 to 1 on III, IV and V each. Unguis bluntly conical. Hairs on hind tibiæ fine, fairly numerous, erect, .09 to .11 mm. long, 1.5 times as long as diameter of tibia in apteræ, twice in alatæ; on antenna, body and cornicles .05 to .07 mm. long. Rostrum as long as body or distinctly longer. Mediæ faint and twice branched. Oviparæ show no swelling of hind tibiæ and no evident sensoria. Males usually apterous but occasionally alate, and with but 2 secondary sensoria on joints III, IV and V, each.

Collections.—On *Pinus contorta* var. *murrayana*, once on *Pinus ponderosa* var. *scopulorum* on young cones, the second generation all acquiring wings and migrating to the young cones. Eggs laid on cones. Recorded in the state at Eldora, hills above Bellvue, and Rocky Mountain National Park; fundatrices, May 13; apterous summer viviparæ, June 16 to Aug. 25; alate viviparæ, June 5 to 25; sexuales, Sept. 15 to Oct. 2; 12 collections; rare.

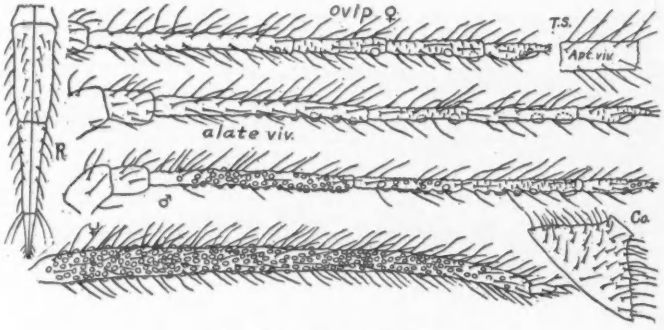

FIG. 33. *Cinara palmerae.*

Cinara palmerae (Gillette).

Gillette, Ann. Ent. Soc. Amer., Vol. 10, p. 135, 1917. *Lachnus.*

Color.—In all forms—Dark brown, with broken pattern of pulverulence, tip of abdomen of oviparæ heavily pulverulent; legs about half dusky and half pale yellow. Cornicles black.

Measurements.—Apterous summer vivipara.—Body 3.5 to 4 mm. long; hind tibiæ 2.2 to 2.5 mm.; first joint of hind tarsi .06 mm. on

outer side, .11 mm. on inner side; second joint .26 to .30 mm.; antennæ 1.3 to 1.5 mm.; joint III .45 to .54 mm.; IV .20 to .30 mm.; V .23 to .31 mm.; VI .15 + .03 to .04 mm.; cornicles .40 to .60 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria very slightly tuberculate on III, 3 to 5; on IV 1 to 3; on V 2 to 3, in alate vivipara; in aptera with 1 on III, IV and V each. Unguis conical. Hairs pointed, fine, numerous, set at angle of 45 degrees, .12 to .17 mm. long, over 1.5 times diameter of tibia in apteræ, about twice in alatæ. Rostrum surpassing cornicles. Mediæ twice forked. Males alate.

Collections.—On *Picea parrayana* and *engelmannii*, on bark of twigs and small branches, in large colonies. Eggs laid on bark of twigs mostly, a few on needles. Recorded in the state at Fort Collins, Paonia, and Tolland; fundatrices, March 16 to May 20; apterous summer viviparæ, May 16 to July 20; alate viviparæ, May 5 to Nov. 5; sexuales, Oct. 6 to Nov. 5; 25 collections; common in parks.

Types in U. S. Nat. Mus., Cat. No. 41942; paratypes in collection of Colo. Agr. Exp. Sta.

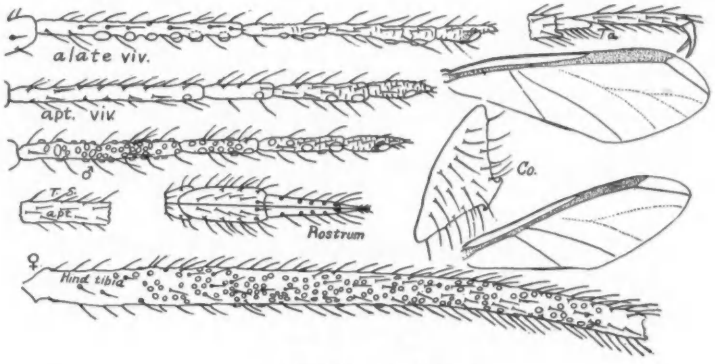

FIG. 34. *Cinara ponderosae.*

Cinara ponderosae (Williams).

Williams, "Aphididae of Nebraska," Univ. Studies, Vol. 10, No. 2, p. 22, 1911. *Lachnus.*

Color.—In all forms.—Metallic golden-brown, with tendency to a pair of dorsal and lateral longitudinal rows of black areas; with broken pattern of white pulverulence; cornicles black; legs mostly black, partly yellow.

Measurements.—Apterous summer vivipara.—Body 2.5 to 4 mm. long; hind tibiæ 2 to 2.75 mm.; first joint of hind tarsi .04 mm. on

outer side, .10 mm. on inner side; second joint .30 mm. long; antennæ 1.17 mm.; joint III .46 to .54 mm.; IV .16 to .20 mm.; V .21 to .28 mm.; VI .12 + .04 to .06 mm.; cornicles .55 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria convex, somewhat tuberculate, 1 to 4 on III, 1 to 2 on IV, 1 on V in alate vivipara; in aptera 1 to 2 on III, 1 on IV, 1 on V, located distally. Unguis conical, short, and thick. Hairs on hind tibiæ pointed, spine-like, rather sparse, set at angle of 45 degrees, .05 mm. long, slightly shorter than diameter of tibia in aptera; in alata .07 to .09 mm. slightly longer than diameter of tibia; on body and cornicles same as on tibiæ. Rostrum attaining or surpassing middle of abdomen. Mediæ faint and usually twice forked, rarely once forked. Males alate.

Collections.—On *Pinus ponderosa* var. *scopulorum* on bark of twigs and small branches in large colonies; eggs laid on needles. Recorded in the state in foothills of eastern slope of Rocky Mountains of Colorado; fundatrices, March 19 to May 2; apterous summer viviparæ, April 11 to Oct. 10; alate viviparæ, April 11 to Oct. 9; sexuales, Oct. 7 to Nov. 25; 39 collections; very common.

Taxonomy.—The specimens named *Lachnus pini* (L.) by Cowen ("Hemiptera of Colorado" Agr. Exp. Sta. Bul. No. 31, p. 117, 1895) were undoubtedly this species.

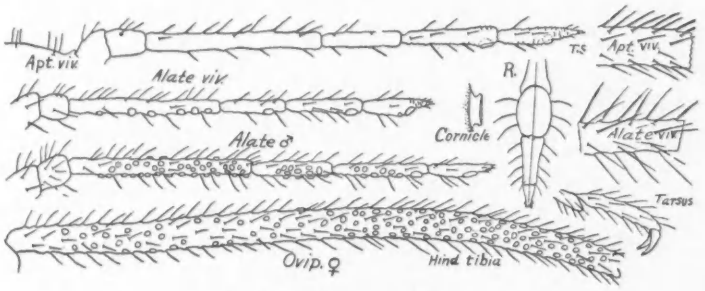

FIG. 35. *Cinara pseudotsugae.*

Cinara pseudotsugae (Wilson).

Wilson, Can. Ent. XLIV, p. 302, 1912. *Lachnus.*

Color.—In all forms.—Pale brownish shading to whitish medially, often tinged with green and with faint dusky dashes, fundatrices and oviparæ darker; with broken pattern of slight pulverulence; legs mostly dusky.

Measurements.—Apterous summer vivipara.—Body 3 mm. long; hind tibiæ 2 mm.; first joint of hind tarsi .05 mm. on outer side, .10 mm.

on inner side; second joint .36 mm.; antennæ 1 and 1.1 mm.; joint III .35 to .42 mm.; IV .15 to .18 mm.; V .18 to .21 mm.; VI .12 + .04 mm.; cornicles hardly more than mere rims, mammiform base rudimentary or absent. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria on joint III 2 to 7; on IV 1 to 2; on V 0; absent in aptera. Unguis conical, stout. Hairs on hind tibiæ, rather stout, pointed, numerous, set at angle of 45 to 60 degrees, .07 to .10 mm. long, hardly as long as diameter of tibia in aptera; .10 to .12 mm. in alata, 1 to 1.5 times as long as diameter of tibia; on antennæ and body finer, .04 to .05 mm. long. Rostrum attaining second or third coxæ. Mediæ twice branched. Males alate.

Collections.—On *Pseudotsuga taxifolia*, on bark of twigs; eggs laid on needles. Recorded in the state near Estes Park, Bellvue and Glen Haven; fundatrices, June 3 to 27; summer apterous viviparæ, June 16 to July 6, and Sept. 1; alate viviparæ, June 20 to Sept. 26; sexuales, Sept. 8 to 27; 9 collections; not common.

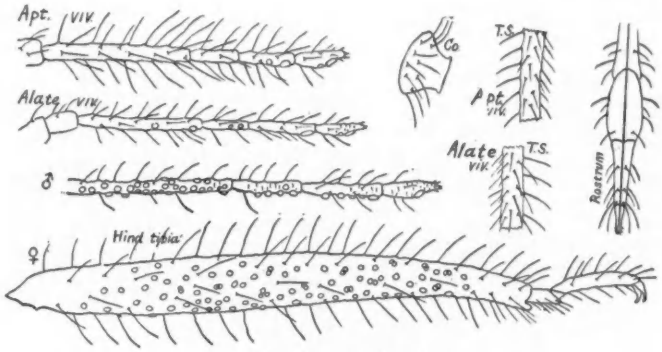

FIG. 36. *Cinara pulverulens.*

Cinara pulverulens (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 40, 1924. *Lachnus.*

Color.—In all forms.—Yellowish-brown, with a pair of longitudinal rows of black areas, vanishing posteriorly; heavily covered throughout with pulverulence; legs mostly pale yellowish.

Measurements.—Apterous summer vivipara.—Body 2.2 to 2.9 mm.; hind tibiæ 1.2 to 1.5 mm.; first joint of hind tarsi .04 mm. on outer side, .09 mm. on inner side; second joint .22 mm.; antennæ .95 mm.; joint III .32 mm.; IV .14 to .16 mm.; V .16 to .19 mm.; VI .11 + .02 mm.; cornicles .15 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate vivipara 2 to 3 on III, 1 to 2 on IV, 1 on V; in aptera very small, 0 to 1 on III, 1 on IV,

and 1 on V. Unguis conical, stubby. Hairs on hind tibiæ pointed, fine, erect, rather numerous, .08 to .10 mm. long, as long or slightly longer than diameter of tibia in aptera; in alatæ .10 to .12 mm., barely twice as long as diameter of tibia. Rostrum attaining first segment of abdomen. Mediæ twice branched (only 5 alatæ studied). Males alate.

Collections.—On *Sabina scopulorum*, on bark of twigs. Recorded in the state in hills near Fort Collins, Laramie-Poudre Tunnel, Masonville, Estes Park, Big Thompson Canon, and Colorado Springs; apterous summer viviparæ, Aug. 1 to Sept. 31; alate viviparæ, Aug. 1 and 22; oviparæ, Sept. 29 to Oct. 17; males, Sept. 29; 8 collections; quite rare.

Types in U. S. Nat. Mus., Cat. No. 42812; paratypes in collection of Colo. Agr. Exp. Sta.

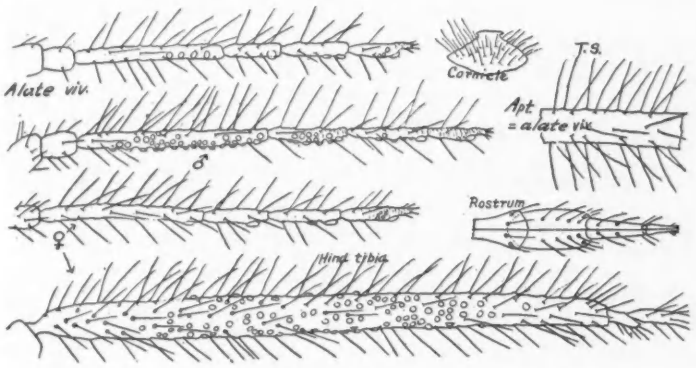

FIG. 37. *Cinara sabinae.*

Cinara sabinae (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 9, 1924. *Lachnus.*

Color.—In all forms.—Light yellowish-brown, marked with dark brown to black on lateral areas, pair of dorsal areas on thorax, solid bands on abdominal segments 5 and 6 and median of 4; heavily pulverulent in cross bands, leaving dark markings exposed; legs almost entirely pale.

Measurements.—Apterous summer vivipara.—Body 3.1 mm.; hind tibiæ 1.4 to 1.8 mm.; first joint of hind tarsi .04 mm. on outer side, .09 mm. on inner side, second joint .25 to .28 mm.; antennæ 1.1 mm.; joint III .35 to .43 mm.; IV .14 to .18 mm.; V .17 to .20 mm.; VI .14 + .03 to .05 mm.; cornicles .30 mm. in diameter at base. Alate vivipara.—Same as aptera or slightly larger.

Structural Characters.—Secondary sensoria in alate vivipara 3 to 6 on III, 1 to 2 on IV, 2 on V; in aptera, 0 on III, 1 on IV and 2 on V. Unguis slender and finger-like; hairs on hind tibiæ, moderately stout, pointed, erect, numerous, .22 mm. long, fully twice as long as diameter of tibia; on body and antennæ .16 mm. long. Rostrum surpassing third coxæ. Mediæ twice branched. Male alate.

Collections.—On *Sabina scopulorum* on bark of twigs, in large colonies; eggs laid on the needles, few on bark. Recorded in the state at Fort Collins, Longmont, Denver, and Big Thompson Canon; fundatrices, April 9 to May 23; apterous summer viviparæ, Aug. 10 to Sept. 31; alate viviparæ, Aug. 10 to 20; sexuales, Oct. 12 to Nov. 7; 15 collections; common, often in injurious numbers, killing twigs.

Types in U. S. Nat. Mus., Cat. No. 41954; paratypes in collection of Colo. Agr. Exp. Sta.

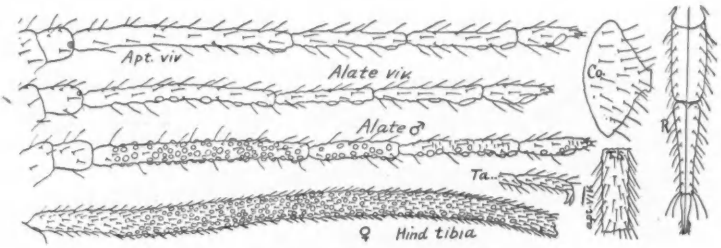

FIG. 38. *Cinara schwarzii.*

Cinara schwarzii (Wilson).

Wilson, H. F., Can. Ent., Vol. 51, p. 46, 1919. *Lachniella.*

Color.—In all adult forms.—Cinnamon-brown, mottled with black to entirely black; with scattered patches and streaks of pulverulence; legs mostly blackish; cornicles black. Young yellow with head dusky.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm.; hind tibiæ 2.1 to 3 mm.; first joint of hind tarsi .06 mm. on outer side, .12 mm. on inner side; second joint .28 mm.; antennæ 1 to 1.6 mm.; joint III .45 to .65 mm.; IV .20 to .32 mm.; V .20 to .33 mm.; VI .10 to .15 + .04 mm.; cornicles .45 to .50 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Hind tibiæ sometimes strongly bent. Secondary sensoria rather large, often irregular, somewhat tuberculate, 3 to 7 on III; 1 to 2 on IV; and 1 on V; in apteræ 0 to 1 on III, IV and V. Unguis bluntly conical, short. Hairs on hind tibiæ pointed, fine, numerous, at angle of 30 degrees or less; in aptera .03 to .05 mm. long, shorter than diameter of tibiæ; in alata .05 to .07 mm. length about equal to diameter of tibia. Rostrum attaining from middle of abdomen to end of body. Mediæ twice branched. Males alate.

Collections.—On *Pinus ponderosa* var. *scopulorum*, on bark of twigs and small branches in colonies; eggs laid on needles. Recorded in the state generally wherever the host occurs on the eastern slope of the Rocky Mountains; fundatrices, April 8 to May 18; apterous summer viviparæ, June 18 to Nov. 8; alate viviparæ, June 18 to Oct. 7; sexuales, Oct. 9 to 27; 35 collections; very common.

Taxonomy.—Near to *C. edulis* Wilson (see *C. edulis* Wilson).

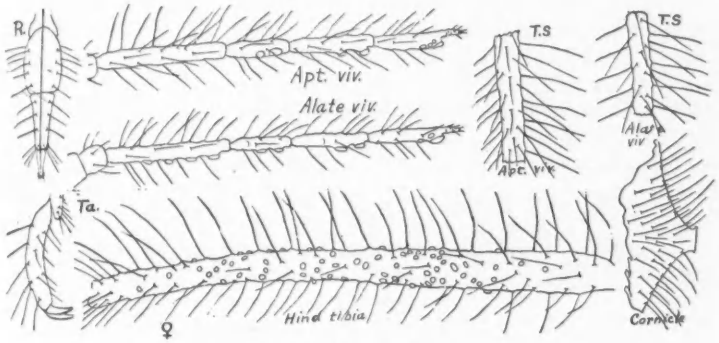

FIG. 39. *Cinara sibiricae.*

Cinara sibiricae (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 17, p. 12, 1924. *Lachnus.*

Color.—Pinkish-cinnamon-brown in aptera with two rows of black areas on dorsum; in alatæ, entirely dull black; covered with more or less pulverulence; tip of abdomen of oviparæ not heavily powdered; legs entirely dusky; cornicles black.

Measurements.—Apterous summer vivipara.—Body 2.6 to 3 mm. by 1.75 to 2.25 mm.; hind tibiæ 1 to 1.2 mm.; first joint of hind tarsi .02 mm. on outer side, .07 mm. on inner side; second joint .29 mm.; antennæ 1 to 1.1 mm.; joint III .26 to .35 mm.; IV .13 to .17 mm.; V .17 to .24 mm.; VI .15 to .20 + .04 to .05 mm.; cornicles .55 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria large and tuberculate; in alate vivipara 4 to 6 on III, 1 to 2 on IV, and 2 to 3 on V; in aptera 0 to 1 on III, 1 to 2 on IV and 2 on V. Unguis arising abruptly, slender, finger-like. Hairs on hind tibiæ, pointed, rather fine, at angle of 80 to 90 degrees, .13 to .18 mm. the longest twice as long as diameter of tibia in aptera; in alata .17 to .20 mm. 3 times diameter of tibia. Rostrum attaining third coxæ. Mediæ once branched, (5 alatæ taken). Males apterous.

Collections.—On *Juniperus sibirica*, on bark of twigs, solitary; eggs laid on needles. Recorded in the state generally

wherever the host plant occurs; fundatrices, June 2 to July 7; apterous viviparæ, June 13 to Aug. 27; alate viviparæ, June 9, 10 and 13; oviparæ, Oct. 9; males, Sept. 11; 19 collections; rather common, but difficult to find on account of its solitary habits.

Types in U. S. Nat. Mus., Cat. No. 41955; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species seems very close to *C. juniperi* (De Geer) differing only in fewer sensoria in alate vivipara, and the once branched mediæ. However, Swain (Ent. News, Vol. 32, p. 213, 1921) states that specimens of this species in the British Museum show the mediæ once branched in two examples out of five. It appears that the Colorado form may belong to the European species. However, the fact that it occurs in remote regions of the Rocky Mountains and on a native host make it appear improbable that it is introduced.

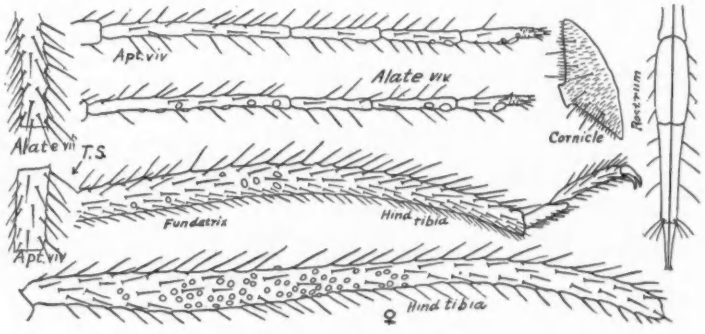

FIG. 40. *Cinara solitaria.*

Cinara solitaria (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 17, 1924. *Lachnus.*

Color.—In all mature forms.—Yellow-brown to dull dusky brown with 6 longitudinal rows of black dots; legs almost entirely dusky; cornicles dusky; young, pale yellow.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3 mm. by 2 mm.; hind tibiæ 1.5 mm.; first joint of hind tarsi .06 mm. on outer side, .11 mm. on inner side; second joint .27 mm.; antennæ 1.3 to 1.5 mm., slender; joint III .41 to .55 mm.; IV .18 to .23 mm.; V .20 to .25 mm.; VI .14 + .06 mm.; cornicles with distinct neck, on mammiform base, .45 mm. in diameter at base of cone. Alate viviparæ.—Same as aptera.

Structural Characters.—Secondary sensoria only slightly tuberculate; in alata 6 to 8 on III, 0 to 1 on IV, 0 on V; in aptera 0 to 1 on III, IV and V each. Unguis cylindrical and terminating in a point. Hairs on outside of hind tibiæ heavy, spine-like, pointed, rather numerous, at angle of 45 to 90 degrees, .07 to .10 mm. long, about as long as diameter of the tibia in aptera*; in alata .09 to .12 mm., 1.5 to twice as long as diameter of tibiæ; on inner side of tibiæ finer and shorter and more drooping; hairs on body and antennæ spine-like and .02 to .05 mm. long; cornicles with two kinds of hairs, one kind spine-like, .05 to .07 mm. long and sparse, the other kind very fine and numerous, .02 mm. long. Rostrum slender, attaining cornicles. Hind tibiæ in fundatrices possessing about 10 scatted sensoria on proximal half. Mediæ faint and twice forked. Males not taken. First pair of femora noticeably thickened in apteræ.

Collections.—On *Pinus ponderosa* var. *scopulorum*, on bark of tender tips at bases of needles, solitary, spider-like in action. Recorded in the state in foothills near Fort Collins, Bellvue, and Estes Park; fundatrices, April 10 to June 12; apterous summer viviparæ, June 20 to Aug. 21; alate viviparæ, June 20; oviparæ, Oct. 1 and 2; 14 collections; rather common but difficult to find on account of solitary habit and position, head down among the crowded bases of needles.

Types in U. S. Nat. Mus., Cat. No. 41957; paratypes in collection of Colo. Agr. Exp. Sta.

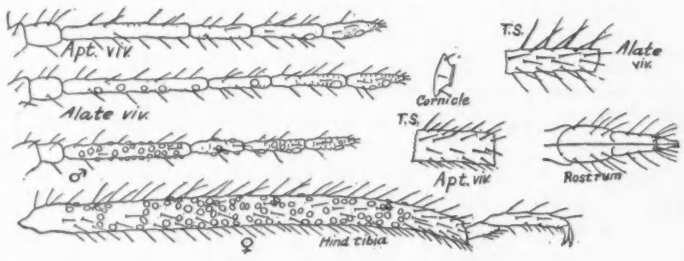

FIG. 41. *Cinara splendens.*

Cinara splendens (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 14, 1924. *Lachnus.*

Color.—In mature viviparæ.—Rusty brown with colorless area on median of first 3 abdominal segments, and 2 longitudinal rows of green to black areas, especially on thorax; younger individuals greenish to water-white; with slight pulverulence, especially on intersegmental lines

*Statement in original description that hairs are twice as long as diameter of tibiae in apterae is in error.

and lateral areas, heavily covering tip of abdomen of ovipara; legs almost entirely pale; cornicles black.

Measurements.—Apterous summer vivipara.—Body 2.2 to 2.6 mm.; hind tibiæ 1.25 to 1.65 mm.; first joint of hind tarsi .05 mm. on outer side, .09 mm. on inner side; second joint .27 mm.; antennæ .9 to 1.1 mm.; joint III .26 to .37 mm.; IV .11 to .14 mm.; V .16 to .19 mm.; VI .11 + .03 to .05 mm.; cornicles with base hardly raised, .07 mm. in diameter, sometimes only rims evident. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate viviparæ 3 to 7 on III, 0 to 1 on IV; 0 to 1 on V; absent in aptera except 1 on V. Unguis conical, stout. Hairs on outer side of hind tibiæ pointed, rather stout, nearly sparse, set at angle of 50 to 70 degrees, .04 to .05 mm., hardly as long as diameter of tibia in aptera; in alata .05 to .08 mm., as long or longer than diameter of tibia. Rostrum stout, attaining third abdominal segment. Mediæ twice branched. Males alate.

Collections.—On *Pseudotsuga taxifolia*, on bark of twigs in colonies; eggs laid on needles. Recorded in the state in hills around Estes Park, Bellvue, Pingree Park, Laramie-Poudre Tunnel and Colorado Springs; fundatrices, May 22 and 28; apterous summer viviparæ, June 5 to Sept. 5; alate viviparæ, June 5 to 20; sexuales, Sept. 8 to Nov. 25; 17 collections; fairly common.

Types in U. S. Nat. Mus., Cat. No. 41956; paratypes in collection of Colo. Agr. Exp. Sta.

Taxonomy.—This species is very close to *C. pseudotsugæ* (Wilson) but biological experiments in which several colonies were reared for several generations indicated the constancy of color differences in hind tibiæ and body, smaller size and shorter tibial hairs.

Cinara taxifoliae (Swain).

Swain, Tr. Am. Ent. Soc., Vol. 44, p. 11, 1918. *Lachnus.*

Color.—Mature viviparæ.—Yellowish-brown to dark brown or black, with 2 longitudinal rows of black areas also lateral areas black; immature stages pale brownish or sordid white with 2 longitudinal rows of green spots; marked with broken pattern of pulverulence, tip of abdomen of oviparæ heavily pulverulent; legs mostly dusky.

Measurements.—Apterous summer vivipara.—Body 3 by 1.5 mm.; hind tibiæ 2 to 2.5 mm.; first joint of hind tarsi .05 mm. on outer side, .10 mm. on inner side; second joint .27 mm.; antennæ 1.1 to 1.4 mm.; joint III .40 to .50 mm.; IV .15 to .21 mm.; V .22 to .25 mm.; VI .13 + .04 mm.; cornicles without perceptibly raised base, though a small area may be darkened. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate viviparæ 3 to 7 on III, 0 to 2 on IV, 0 to 1 on V; absent in aptera. Unguis conical, short. Hairs on hind tibiæ pointed, fine, numerous, at angle of about 35 degrees, .05 to .07 mm., not as long as diameter of tibia in aptera; .06 to .08 mm. in alata, as long as diameter of tibia; hairs on body and antennæ similar but erect. Rostrum attaining first segment of abdomen. Males alate.

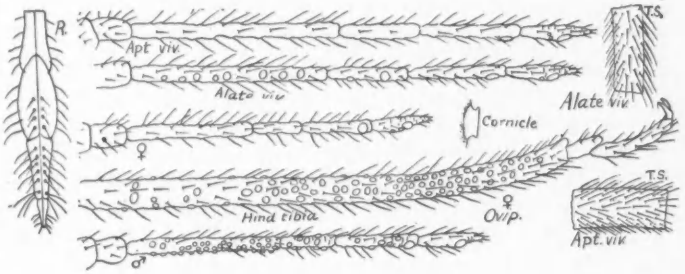

FIG. 42. *Cinara taxifoliae.*

Collections.—On *Pseudotsuga taxifolia* on bark of twigs in colonies; eggs laid on needles. Recorded in the state throughout Larimer County wherever the host plant occurs; fundatrices, May 15 to June 26; apterous summer viviparæ, June 8 to Aug. 21; alate viviparæ, June 20 to July 26; sexuales, Sept. 12 to Oct. 10, oviparæ until Nov. 10; 27 collections; common.

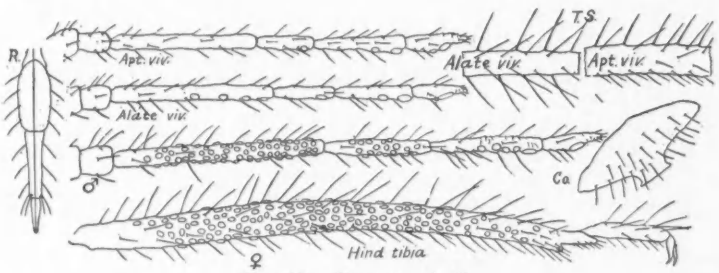

FIG. 43. *Cinara terminalis.*

Cinara terminalis (Gillette and Palmer).

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 17, p. 19, 1924. *Lachnus.*

Color.—In all forms.—Light cinnamon-brown or pinkish-amber, sometimes tinged with green, rather dusky on middle of dorsum from thorax to seventh abdominal segment; with pulverulence on head and

thorax and lateral areas and intersegmental lines on abdomen; cornicles black; legs half or slightly more, dusky, remainder pale yellow.

Measurements.—Apterous summer vivipara.—Body 2.25 mm.; hind tibiæ 1.5 to 1.7 mm.; first joint of hind tarsi .06 mm. on outer side, .12 mm. on inner side; second joint .28 mm.; antennæ 1 to 1.1 mm.; joint III .35 to .50 mm.; IV .11 to .18 mm.; V .17 to .24 mm.; VI .11 + .03 to .05 mm.; cornicles .30 to .40 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria in alate viviparæ 4 on III, 1 on IV, 2 on V; in apteræ 0 on III, 1 on IV and 2 on V. Unguis conical, large. Hairs pointed, rather sparse, set at angle of 65 degrees, .05 to .08 mm.; length subequal with diameter of tibia in apteræ; in alatæ at angle of 70 to 80 degrees, .08 to .10 mm.; 1.5 to 2 times diameter of tibiæ. Rostrum nearly as long as body. Mediæ twice forked. Males alate.

Collections.—On *Pinus edulis*, on bark of tender twigs, solitary; eggs laid on needles. Recorded in the state near Owl Canon in Larimer County and Walsenburg; fundatrices, June 15; apterous summer viviparæ, June 15 to Oct. 5; alate viviparæ, June 15 to Oct. 19; oviparæ, Oct. 13 to 27; males, Oct. 13; 8 collections; rather common but difficult to find on account of solitary habits.

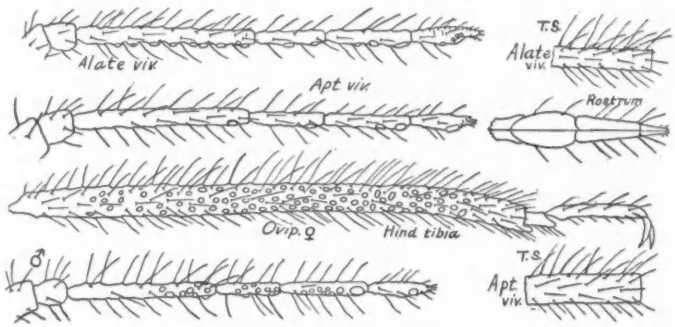

FIG. 44. *Cinara vandykei.*

Cinara vandykei (Wilson).

Wilson, H. F., Can. Ent., Vol. 51, p. 19, 1919. *Lachniella.*

Color.—In all forms.—Dark rufous brown; mottled with yellowish in alatæ; pulverulence not evident in apteræ, present on intersegmental lines, lateral areas and entire dorsum of seventh abdominal segment; legs mostly black.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3 by 1.5 mm.; hind tibiæ 1.7 mm.; first joint .04 mm. on outer side, .09 mm.

on inner side; second joint .30 mm.; antennæ 1.25 mm.; joint III .45 to .55 mm.; IV .16 to .19 mm.; V .20 to .25 mm.; VI .14 to .18 + .03 mm.; cornicles .30 to .50 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria slightly tuberculate, in alate vivipara 6 to 10 on III, 3 to 2 on IV; 1 to 2 on V; in aptera 1 to 2 on III, 0 to 2 on IV and 0 to 1 on V. Unguis conical, short. Hairs on hind tibiæ pointed, fine, fairly numerous, nearly erect to erect, .08 to .10 mm. long, slightly longer than diameter of tibiæ in aptera; in alate vivipara almost twice as long as diameter. Rostrum attaining middle of abdomen. Mediæ twice branched. Males apterous.

Collections.—On *Picea engelmanni*, on bark of twigs; eggs laid on needles. Recorded in the state in Rocky Mountain National Park and Pingree Park; fundatrices, June 11 and July 7; apterous summer viviparæ, July 16 to 28; alate viviparæ, July 16 to 28; oviparæ, July 20 to Aug. 24; males, July 20; 5 collections; rather rare.

Subtribe **Lachnina.**

Characters.—Radial sector arising some distance proximad of apex of stigma, straight or curved; media slender but more distinct than in *Cinarina*. First joint of hind tarsi with outer side shorter than half of inner side. Terminal segment of rostrum inconspicuous. Ocular tubercles evident. Unguis decidedly shorter, usually less than half of base of VI. Color, brown to black, wings often with smoky bands or spots. Living on woody parts of trees and plants.

KEY TO GENERA OF LACHNINA.

A. Rostrum never much longer than body.
  B. Stigma not elongated to apex of wing. Unguis not longer than half of base of VI. (Page 875) ..... **Lachnus**
  BB. Stigma elongated to apex of wing. Unguis longer than half of base of VI. (Page 879) ..... **Longistigma**
AA. Rostrum much longer than body. (Page 879) ..... **Stomaphis**

Genus **Lachnus** Burmeister.*

Type, *Aphis roboris* Linnaeus. Burmeister, Handbuch der Ent., Vol. 2, pt. 1, p. 91, 1835.

Characters.—Antennæ with rather stout hairs. Rostrum obtuse, never much longer than body. First joint of hind tarsi trapezoidal, outer side at least one-third as long as inner side. Radial sector slightly to strongly curved, arising some distance proximad of apex of stigma; media fine but not faint; wings often smoky. Living on bark of *Quercus* and *Rosa* sp.

Genotype, *Lachnus roboris* (Linnaeus). (See below.)

**Pterochlorus* Rondani (Synonym). See footnote under *Cinara*.

KEY TO SPECIES OF LACHNUS.

A. Dorsal tubercle absent. Radial sector distinctly curved.
B. Secondary sensoria present in apterae, large and tuberculate in alate viviparae. (Page 877) ..... **rosæ**
BB. Secondary sensoria absent in apterae. (Page 876) ..... **montanus**
AA. Dorsal tubercle present. Radial sector almost straight. (Page 878) **. salignus**

[Genotype **Lachnus roboris** (Linnaeus).]

Linnaeus, Edition 10, Systema Naturae, p. 452, 1758. *Aphis.*

Color.—In all forms.—Blackish-brown to metallic-black; legs brown; wings smoky.

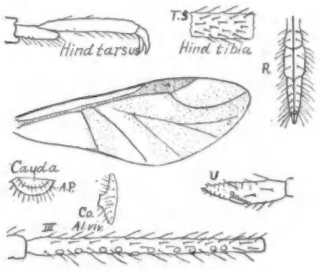

FIG. 45. *Lachnus roboris.*

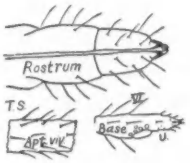

FIG. 46. *Lachnus montanus.*

Measurements.—Alate vivipara.—Body 3.2 to 3.4 mm.; hind tibiæ 3.6 mm.; first joint of hind tarsi .06 on outer side, .14 on inner side; second joint .30 mm.; antennæ 2 mm.; joint III .73 mm.; IV .32 mm.; V .35 mm.; VI .15 + .06 mm.; cornicles .40 mm. in diameter at base.

Structural Characters.—Secondary sensoria rather flat and small, in irregular row along entire length of joints, on III, 6, (10 to 12 in examples from Cholodkovsky); 3 or 4 on IV, 0 on V, in alate viviparæ. Unguis conical and heavy. Hairs pointed, spine-like, on hind tibiæ almost sparse, at angle of 30 to 40 degrees, .04 mm. long, hardly half as long as diameter of tibia. Rostrum attaining abdomen; rather stout, terminal segment inconspicuous. Stigmæ short and broad; radial sector distinctly curved. Mediæ twice forked.

Hosts.—Quercus, also recorded on *Pinus sylvestris* and *Picea excelsa*. Not recorded from the state. (Data from Theobald (Aphid. Gr. Brit., Vol. 3, 1929) and from specimens determined and sent by Cholodkovsky.)

Lachnus montanus (Wilson).

Wilson, Can. Ent., Vol. 51, p. 42, 1919. *Lachniella.*

Color.—In all forms.—Rusty or yellowish-brown; legs brown.

Measurements.—Apterous summer vivipara.—Body 3.5 to 3.9 by 2 mm.; hind tibiæ 2.1 mm.; first joint of hind tarsi .06 mm. on outer

side, .13 mm. on inner side; second joint .23 mm.; antennæ 1.7 mm.; joint III .72 to .80 mm.; IV .31 to .38 mm.; V .40 mm.; VI .17 + .08 mm.; cornicles .70 mm. in diameter at base.

Structural Characters.—Secondary sensoria absent on III, 0 to 2 small ones on IV, 0 to 1 on V. Unguis heavy, parallel-sided with conical tip. Hairs pointed, spine-like, on hind tibiæ at angle of 45 degrees, sparse, .03 to .05 mm. long, about half as long as diameter of tibia; on antennæ and body about the same as on tibiæ. Rostrum surpassing third coxæ, broad and rather obtuse, tip very short and not distinctly separated.

Collections.—On *Quercus* sp. Recorded in the state at Cimmarron; apterous summer viviparæ, Aug. 22; no other forms taken; 1 collection; apparently rare.

Taxonomy.—This species is apparently very close to *A. roboris* L., the only differences noted being shorter tibiæ and larger cornicles in *montanus*.

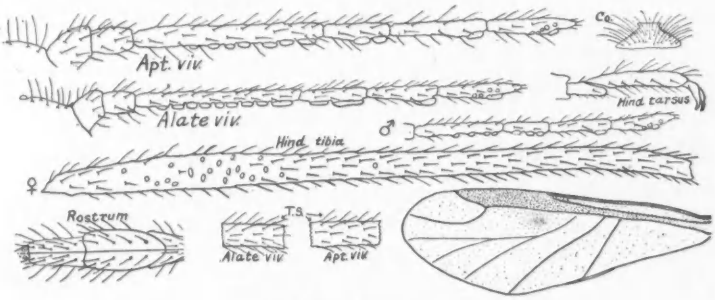

FIG. 47. *Lachnus rosae.*

Lachnus rosae Cholodkovsky.

Cholodkovsky, Zool. Anz. XXII, p. 471, 1899.

Color.—Yellowish or rusty-brown to blackish; legs dusky throughout; wings slightly smoky with darker area between media and stigma.

Measurements.—Apterous summer vivipara.—Body 2.7 to 3.5 mm.; hind tibiæ 1.50 to 2 mm.; first joint of hind tarsi, .05 mm. on outer side, .10 to .11 mm. on inner side, second joint .27 to .32 mm.; antennæ 1.3 to 1.6 mm.; joint III .50 to .63 mm.; IV .18 to .25 mm.; V .20 to .29 mm.; VI .19 to .21 + .04 to .06 mm.; cornicles .20 to .25 mm. in diameter at base. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria as large as diameter of antenna, round, strongly convex, arranged in single row along most of joints; 5 to 10 on III, 1 to 3 on IV, 0 on V in both alatæ and apteræ. Unguis conical and stout. Hairs pointed, fine on hind tibiæ, at angle of 45 degrees, .04 to .05 mm. long, about half as long as diameter of

tibiæ; on antennæ same as on tibiæ; on body and cornicles .07 to .08 mm. long and erect. Rostrum attaining third coxæ, rather broad and obtuse, terminal segment distinct but short. Stigma rather broad but not short; radial sector strongly curved; mediæ twice forked, slightly fainter than other veins. Males apterous.

Collections.—On *Rosa fendleri* and other wild species; in colonies, on bark of stems, near ground. Recorded in the state in foothills near Fort Collins, Bellvue and Log Cabin; apterous summer viviparæ, Aug. 18 to Oct. 25, (alate viviparæ presented by G. F. Knowlton from Logan, Utah, taken June 9); sexuales, Oct. 15 to 25; 7 collections; not common.

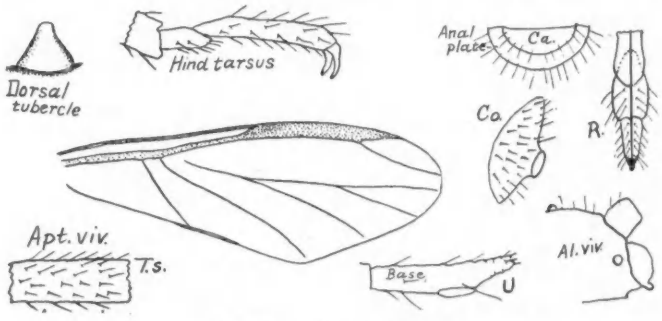

FIG. 48. *Lachnus salignus.*

Lachnus salignus (Gmelin).

Gmelin, Systema Natura I., p. 2209, No. 62, 1788. *Aphis.*
Syn. LeBaron, Second Rept. Nox. and Ben. Ins. Ill., p. 138, 1872. *Lachnus dentatus.*

Color.—In all forms.—Blackish with many hairs which cause a gray appearance; legs mostly rufous; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 4.5 to 5.5 mm.; hind tibiæ 3 to 3.5 mm.; first joint of hind tarsi .05 mm. on outer side, .16 mm. on inner side; second joint .40 mm.; antennæ 1.8 to 2 mm.; joint III .70 to .85 mm.; IV .26 to .35 mm.; V .23 to .32 mm.; VI .17 + .06 to .08 mm.; cornicles .40 to .55 mm. in diameter at base of cone. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria circular to oval, often nearly equalling diameter of antenna, strongly convex, about 15 on III, 4 on IV, 0 to 1 on V in alate viviparæ; in apteræ, 1 on III, 1 to 3 on IV, occasionally 1 on V. Unguis conical, heavy. Hairs pointed; on hind tibiæ sparse, at angle of 30 degrees, .05 mm. long, hardly half as long as diameter of tibia in apteræ; .05 to .07 mm. almost or quite as long as diameter of tibiæ in alatæ. Rostrum attaining between second and third coxæ. Stigma long and narrow ending in acute point on margin of wing; radial sector very slightly curved, arising a little distance

proximad of end of stigma; media twice forked; hind wings with 2 cross veins.

Collections.—On *Salix* sp., on bark; in large colonies. Recorded in the state at Fort Collins and Denver, apterous viviparæ, July 10 to Nov. 10; alate viviparæ, Aug. 9 to Nov. 30; sexuales and fundatrices not taken; 25 collections; common.

Taxonomy.—This species was used as type for *Tuberolachnus* Mordvilko on account of the dorsal tubercle. The practically straight radial sector would also seem to separate it from *Lachnus*. Observation of other species in the group indicates that the two characters are not correlated and therefore do not represent a genus complex.

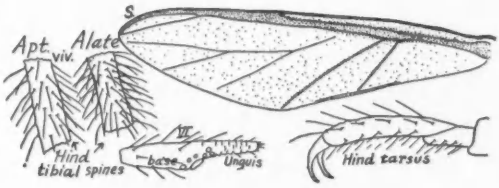

FIG. 49. *Longistigma caryae.*

[Genus **Longistigma** Wilson.]

Type, *Aphis caryae* Harris. Wilson, Can. Ent., Vol. 41, p. 385, 1909.

Characters.—Stigma very long and narrow, ending in an acute point and extending to tip of radial sector; radial sector almost straight, arising some distance proximad of apex of stigma; mediæ fine but not faint, twice branched; hind wings with two cross veins. Unguis elongate, finger-like. Antennæ and legs with prominent hairs. Found on woody parts, as trunks and limbs of trees. Not recorded in the state.

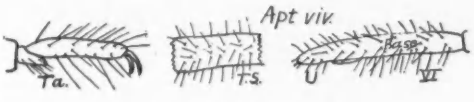

FIG. 50. *Stomaphis quercus.*

[Genus **Stomaphis** Walker.]

Type, *Aphis quercus* Linnaeus. Walker, Zoologist, Vol. 28, p. 2000, 1870.

Characters.—Rostrum much longer than body. Unguis hardly more slender than base of VI. Hairs on antennæ very fine and numerous. Tarsi rather stout, first joint nearly triangular. Radial sectors somewhat curved; mediæ twice branched. Hind wings with media and cubitus widely separated. Males apterous, with rudimentary mouth parts. Ocular tubercles distinct. Not known from Colorado.

Subtribe **Tramina.**

Characters.—Radial sector arising some distance back of tip of stigma and more or less curved. Rostrum obtuse, terminal joint minute. Second joint of hind tarsi at least half as long as tibia; first joint minute, almost triangular. Living on roots of plants and in nests of ants.

Genus **Trama** Hayden.

Type, *Trama troglodytes* Heyden. Heyden, Mus. Senkb., Vol. 2, p. 293, 1837.

Characters.—Cornicles absent in apteræ, at least. Hairs fine, pointed, numerous. Cauda semilunar; anal plate entire. Hind tarsi at least half as long as tibia. Eyes small, especially in apteræ.

Genotype, *Trama troglodytes* Heyden. (See below.)

KEY TO SPECIES OF TRAMA.

A. Hind tarsi .5 to .8 of length of tibia. Eyes of few facets only, in apterae; cornicles present in alatae. (Page 880) ..... **troglodytes**

AA. Hind tarsi .9 of tibiae. Eyes of 15 facets or more in apterae; cornicles not evident in alatae. (Page 881) ..... **oculata**

[Genotype **Trama troglodytes** (Heyden).]

Heyden, Ent. Beitr. Mus. Senk., Vol. 2, p. 293, 1837.

Color.—In all forms.—Pale yellowish-white to pearly-white or dull brownish-green.

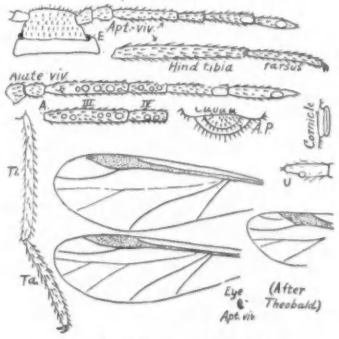

FIG. 51. *Trama troglodytes.*

Measurements.—Apterous summer vivipara.—Body 2.5 to 3.5 mm.; hind tibiæ .90 mm.; second joint of hind tarsi .72 mm., more than half as long as hind tibiæ; antennæ usually half the length of the body; joint III nearly or quite equal to IV + V; IV less than half III, much shorter than V; V longer than VI; unguis very short and blunt with large sensorium at its base. Alate vivipara.—About the same as aptera.

Structural Characters.—Secondary sensoria of various sizes, 5 to 6 on III, 2 to 3 on IV in alate viviparæ; absent in apteræ. Cornicles absent in apteræ, in alate viviparæ present as hardly more than slightly raised rims. Hairs numerous on body and all appendages. Eyes in apteræ very small and dark, "of a few facets only." Rostrum attaining .50 to .66 of length of body.

Hosts.—On the roots of compositæ and in nests of ants. [Data from Theobald, (Aphid. Gr. Brit., Vol. 3, 1929) and from examples determined and sent by Cholodkovsky.]

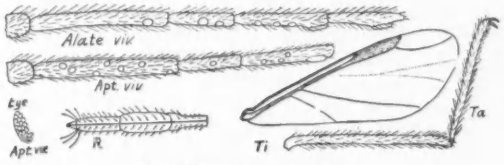

FIG. 52. *Trama oculata.*

Trama oculata Gillette and Palmer.*

Gillette and Palmer, Ann. Ent. Soc. Amer., Vol. 23, p. 547, 1930.

Color.—Pale whitish in young to olive-brown in older examples; legs yellowish.

Measurements.—Apterous vivipara.—Body 3 mm.; hind tibiæ 1 mm.; first joint of hind tarsi minute, less than .05 mm. long; second joint .95 mm. long; antennæ 1.50 mm. joint III .45 mm.; IV .19 mm.; V .29 mm.; VI .22 + .06 mm. Alate vivipara.—Same as aptera or slightly smaller.

Structural Characters.—Rostrum broadly lanceolate, attaining middle of abdomen. Unguis conical. Primary sensoria long and flat; secondary sensoria flat, indistinct, and irregularly shaped, scattered about 7 on III, 1 on IV, and 3 on V, in aptera; in alatæ 0 to 1 apparent on III, 2 on IV, 2 to 3 on V. Hairs pointed, fine, numerous and drooping, about .03 mm. long, on hind tibiæ, as long as half diameter of tibia. Cauda semilunar, broader than long. Eyes normal; in aptera containing more than 15 facets; ocular tubercles consisting of 3 finger-like and diverging facets. Cornicles apparently absent in both apteræ and alatæ. Radial sector very slightly curved; media once forked; stigma rather broad.

Collections.—On *Taraxacum officinale*, on roots and in ant's nests. Recorded in the state in foothills near Masonville and in Longmont; apterous viviparæ, Feb. 23 in nature, Jan. 18 in greenhouse; alate viviparæ, Jan. 18; 2 collections; very rare, not recorded in state previous to 1929.

Types in U. S. Nat. Mus., Cat. No. 43001; paratypes in collection of Colo. Agr. Exp. Sta.

*After manuscript was printed a letter was received from A. K. Mordvilko saying *T. oculata* seems identical with *Tr. rara* Mordvilko.

Tribe **Callipterini.**

Characters.—Wax glands often present. First tarsal joint approximately triangular. Cauda knobbed or semilunar. Anal plate usually bilobed. Antennæ long and slender with few sensoria. Radial sector curved, often faint or absent; media twice forked, never faint. Living free on foliage of plants.

KEY TO SUBTRIBES OF CALLIPTERINI.

A. Cornicles on low conical base. Wax glands present. (Page 882) . **Phyllaphidina**
AA. Cornicles not on low conical base (unless in *Monellia*).
B. Radial sector faint or lacking. Wings often banded. (Page 887) . **Callipterina**
BB. Radial sector distinct. Wings never banded.
C. Ocular tubercles lacking. (Page 905) ..... **Saltusaphidina**
CC. Ocular tubercles present.
D. Secondary sensoria oval to narrow, transverse. Oviparae with long ovipositor. (Page 911) ..... **Drepanosiphina**
DD. Secondary sensoria circular. Oviparae without long ovipositor.
E. Hairs not conspicuous on body and antennae. Hind tarsi slender; second joint at least five times as long as first joint. Cornicles not evident. (Not recorded in the state) ..... **Monaphidina**
EE. Hairs conspicuous on body and antennae. Hind tarsi not slender; second joint shorter than five times first joint.
F. Cornicles present.
G. Cornicles truncate, sculptured, usually reticulate. (Page 915) ..... **Chaitophorina**
GG. Cornicles cylindrical or vasiform, smooth or faintly reticulated. (Page 927) ..... **Pterocommina**
FF. Cornicles absent. (Page 926) ..... **Fullawayina**

Subtribe **Phyllaphidina.**

Characters.—Cornicles reduced to mere rings on low conical bases. Frontal tubercles not evident. Antennæ 6-jointed, bearing short hairs; unguis of joint VI many times shorter than base. Cauda semilunar or knobbed. Wax glands present. First tarsal joint triangular. Radial sector curved. Media twice branched. Oviparous females producing several eggs, often alate. Living free or in folded leaves, usually protected with flocculent secretion.

KEY TO GENERA OF PHYLLAPHIDINA.

A. Anal plate deeply cleft and V-shaped. (Page 883) ..... **Shivaphis**
AA. Anal plate not deeply cleft.
B. Cauda knobbed, anal plate somewhat bilobed. (Page 883) ..... **Phyllaphis**
BB. Cauda not knobbed, anal plate entire.
C. Antennal joint II shorter than either I or IV in apterae. Fore wing with media arising proximad of stigma.
D. Oviparous female with annular sensoria on antennae. (Page 883), **Neophyllaphis**
DD. Oviparous females with small transverse sensoria. (Page 883) . **Tamalia**
CC. Antennal joint II longer than I and subequal with IV in apterae. Fore wing with media arising from stigma. (Page 885) .... **Stegophylla**

[Genus **Shivaphis** Das.]

Type, *Shivaphis celti* Das. Das, Mem. Ind. Mus., Vol. 6, p. 246, 1918.

Characters.—Cornicles very short, hardly more than rings. Frontal tubercles not evident. Antennæ 6-jointed. Secondary sensoria elliptical, transverse. Fore wings with mediæ twice branched; hind wings with media and cubitus. Cauda knobbed, elongate. Anal plate deeply divided. Males alate. Oviparæ apterous. Wax glands present. Not recorded in the state.

[Genus **Phyllaphis** Koch.]

Type, *Aphis fagi* Linnaeus. Koch, Die Pflanzenlause Aphiden, p. 248, 1857.

Characters.—Cornicles mere flanges on very low conical bases. Antennæ 6-jointed, minutely setose; sensoria narrowly oval. Fore wings with the mediæ twice branched, hind wings with media and cubitus faintly indicated. Cauda knobbed. Anal plate slightly emarginate. Males usually winged; oviparæ apterous, laying several eggs. Living on foliage, sometimes causing curling of leaves. Not recorded in the state.

[Genus **Neophyllaphis** Takahashi.]

Type, *Neophyllaphis podocarpi* Takahashi. Takahashi, Can. Ent., Vol. 52, p. 19, 1920.

Characters.—Cornicles slightly elevated. Antennæ 6-jointed, with narrow transverse sensoria. Fore wings with radial sector slightly curved, mediæ twice branched. Hind wings with media and cubitus. Cauda not knobbed but large and slightly constricted at base and at middle. Wax glands present. Oviparæ with annular sensoria. Living free on plants. Not recorded in the state.

Genus **Tamalia** Baker.

Type, *Pemphigus coweni* Cockerell. Baker, Generic Classification of the Hemipterous Family Aphididae, Bul. 826, p. 24, 1920.

Characters.—Frontal tubercles absent. First tarsal joint triangular. Cornicles mere flanges on low, conical bases. Antennæ 6-jointed, minutely setose and with narrow sensoria. Fore wings with mediæ twice* branched and arising proximad of stigmæ, hind wings with media and cubitus. Cauda broader than long and rounded. Anal plate entire in all female forms. Eyes in apteræ of 3 facets only. Sexes both alate. Oviparæ laying many eggs. Living concealed in pseudo-galls on leaves.

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*Baker's statement, in his description of the genus, that the media is once branched is evidently an error or based on an exceptional specimen. No such statement occurs in the descriptions by Cockerell, Cowen, (Gillette and Baker, Colo. Agr. Exp. Sta. Bul. 31, 1895), or Gillette (Can. Ent., Vol. 41, p. 41, 1909), for the Colorado examples, nor by Davidson (Jo. Ec. Ent., Vol. 16, p. 559, 1911), or Essig (Pom. Jo. Ent. Zool., Vol. 7, p. 187, 1915), in their descriptions of the California examples. The numerous alate examples in the collection of the Colo. Agr. Exp. Sta. all have mediae twice branched.

Genotype **Tamalia coweni** (Cockerell).

Cockerell, Can. Ent., Vol. 37, p. 392, 1905. *Pemphigus.*
(For fuller description see Gillette, Can. Ent., Vol. 41, p. 41, 1909. *Phyllaphis*).

Color.—Sordid yellow to nearly black with dark bands on all segments in all forms except males, which are light yellow without markings; heavy covering of waxy threads on venter of abdominal segments 5, 6 and 7 in alate oviparæ, absent in viviparæ; wings hyaline; legs dusky to blackish, excepting males.

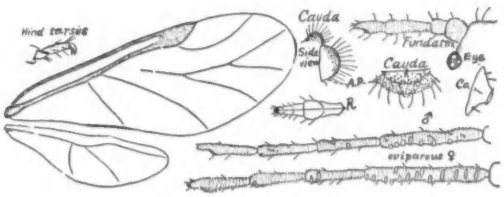

FIG. 53. *Tamalia coweni.*

Measurements.—Fundatrix. Body 1.25 to 1.50 mm.; stout pyriform; hind tibiæ .22 to .26 mm.; hind tarsi with first joint triangular, second joint .07 mm.; antennæ .30 mm.; joint I .05 mm.; II .04 mm.; III .12 mm.; IV .06 + .03 mm.; cornicles about .09 mm. in diameter at base of flat cone; antennæ and body minutely setulose. Alate oviparæ.—Body 1.5 to 1.7 mm. long; hind tibiæ .41 to .51 mm.; second joint of hind tarsi .09 mm.; antennæ .65 to .85 mm.; joint I .06 mm.; II .05 mm.; III .26 mm.; IV .11 to .13 mm.; V .12 mm.; VI .11 + .02 mm.; cornicles .10 to .12 mm. in diameter at base of cone. Alate vivipara.—Same as ovipara except that hind tibiæ are .60 mm. long.

Structural Characters.—Media twice forked. Hairs in fundatrix pointed, curved, sparse, about .04 mm. long on body; on legs about .02 mm.; in alatæ blunt, straight and .01 mm. to .02 mm. long. Unguis bluntly conical. Antennæ minutely setulose and annulated. Secondary sensoria transverse elongate, slightly tuberculate about 13 to 15 on III, 4 to 5 on IV, and 0 on V in alatæ, absent in apteræ. Rostrum blunt, barely attaining second coxæ. Males alate.

Collections.—On *Arctostaphylos uva-ursi*, in pod-shaped pseudogalls formed by causing one-third of leaf to fold lengthwise on remaining two-thirds, inclosing the lice and swelling so as to resemble minute pea pods, both green and red, from 10 to 20 mm. long. Recorded in the state in foothills above Bellvue, Fort Collins, in Big Thompson Canon and Estes Park; fundatrices, July 15 to Aug. 8; alate viviparæ, Aug. 5 to Oct.; sexuales, Aug. 5 and 22; 5 collections; very rare.

Genus **Stegophylla** Oestlund.

Type, *Phyllaphis quercicola* Baker. Oestlund, "A Synoptical Key to the Aphididae of Minnesota," 19th Rept. St. Ent. Minn., p. 146, 1922.

Characters.—Frontal tubercles lacking. Unguis much shorter than base of VI. Cornicles mere rings on low conical bases. Antennæ 6-jointed; not noticeably setose, nor with evident hairs; joint II distinctly longer than I and subequal with IV in apterous forms. Secondary sensoria circular. Fore wings with mediæ simple or twice branched* and arising from the stigmæ. Cauda broader than long and rounded, anal plate entire in all female forms. Males usually alate but sometimes apterous. All other forms apterous. Oviparæ laying many eggs. Summer forms covered with flocculent material. Living free on leaves and twigs or in folded leaves of *Quercus*. Only two species known and these seem to be very similar.

Genotype, *Stegophylla quercicola* Baker. (See below.)

KEY TO SPECIES OF STEGOPHYLLA.

A. Hind wings with two cross veins. (Page 885).....**quercicola**
AA. Hind wings with one cross vein. (Page 886).....**quercifoliae**

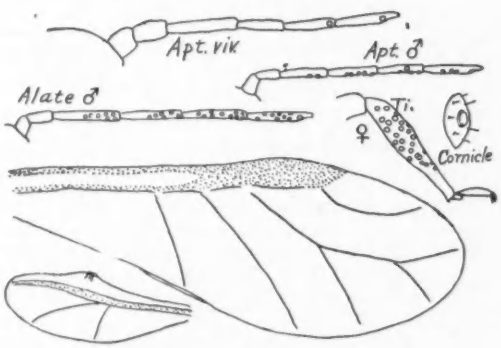

FIG. 54. *Stegophylla quercicola.*

[Genotype **Stegophylla quercicola** (Baker).]

Baker, Ent. News, Vol. 27, p. 362, 1916. *Phyllaphis.*
(For fuller description see Davis, Ent. News, Vol. 22, p. 241. *Phyllaphis querci* Fitch.)

Color.—Pale greenish or yellow to brownish with heavy flocculence; legs pale greenish.

*Oestlund, in his original description of the genus, says, "Mediae of forewings with only one branch," but Davis, (Ent. News, 1911, Vol. 22, p. 241) states and figures venation of media as varying from two branches to simple. Baker applied the name *quercicola* n. n. to the insect described by Davis in above-mentioned reference. Davis' description is accordingly used as basis for the generic description here given.

Measurements.—Apterous vivipara.—Antennæ hardly a third as long as the body, usually 6-jointed, but often 5; usually III and VI subequal, II and IV subequal, V longer than IV but shorter than VI.

Structural Characters.—Abdomen with 6 longitudinal rows of wax glands. Cornicles merely dusky rings. Cauda subobsolete. Secondary sensoria circular, found only in males and hind tibiæ of oviparæ. Mediæ simple or once or twice forked. Rostrum hardly reaching second coxæ. Males both alate and apterous. Oviparæ apterous, with basal two-thirds of hind tibiæ distinctly swollen and bearing many circular sensoria.

Hosts.—*Quercus agrifolia* and *wizlensis*, free on leaves and twigs or in pseudo-galls on edges of leaves. (Data from Davis, (Ent. News, Vol. 22, p. 241, 1911.) Not recorded in the state.

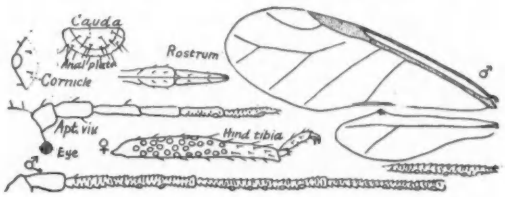

FIG. 55. *Stegophylla quercifoliae.*

Stegophylla quercifoliae (Gillette).

Gillette, Ent. News XXV, p. 272, 1914. *Phyllaphis.*

Color.—Yellow or yellowish-green covered with flocculence; eyes bright red; legs yellow to brown.

Measurements.—Apterous vivipara.—Body 1.1 to 1.5 mm.; hind tibiæ .40 mm.; first joint of hind tarsi triangular, second joint .10 mm.; antennæ .50 mm.; joint I .04 mm.; II .07 to .09 mm.; III .09 to .15 mm.; IV .08 to .10 mm.; V .10 to .12 mm.; VI .12 + .02 to .03 mm.

Structural Characters.—Cornicles mere pores on a darkened area, hardly raised. Hairs very sparse, .01 to .02 mm. long. Secondary sensoria present only in male and hind tibiæ of oviparæ. Unguis finger-like; antennæ imbricated. Rostrum barely attaining second to third coxæ. Males alate. Oviparæ with hind tibiæ swollen on proximal two-thirds and bearing many large circular sensoria. Mediæ quite constantly twice forked. Hind wings with only one cross vein.

Collections.—On *Quercus undulata* and other scrub oaks, free on leaves or in folded leaves. Recorded in southern part of the state on both eastern and western slopes of the Rocky Mountains; apterous viviparæ, June 30 to Oct. 7; alate viviparæ unknown; sexuales, Oct. 18; 8 collections.

Subtribe **Callipterina.**

Characters.—Antennæ bearing only minute hairs or bristles. Cornicles truncate, never much longer than broad, sometimes mere rims or pores (in *Monellia*). Cauda usually knobbed; anal plate usually indented or bilobed in viviparæ. Apterous forms usually with capitate hairs. Viviparæ, including fundatrices, usually alate. Fore wings with media twice branched; radial sector usually faint. Hind wings with both media and cubitus. Living on leaves or bark, usually solitary.

KEY TO GENERA OF CALLIPTERINA.

A. Hairs prominent on antennae and cornicles. (Page 887)..... **Callipterinola**
AA. Hairs not prominent on antennae and cornicles.
B. Frontal tubercles not distinct.
C. Anal plate distinctly divided or bilobed.
D. Cornicles truncate, fairly well developed. (Page 888)..... **Myzocallis**
DD. Cornicles mere pores. (Page 894)..... **Monellia**
CC. Anal plate only slightly indented or entire.
D. Imbrications on antennae minutely setose; unguis at least half as long as base of VI. (Page 895)..... **Symydobius**
DD. Imbrications not setose; unguis less than half as long as base of VI. (Page 897)..... **Chromaphis**
BB. Frontal tubercles distinct.
C. Hairs capitate in alatae. (Page 898)..... **Cepegillettea**
CC. Hairs not capitate in alatae.
D. Secondary sensoria circular or oval.
E. Cornicles not on mammiform base. (Page 899)..... **Calaphis**
EE. Cornicles on mammiform base. (Page 902)..... **Oestlundiella**
DD. Secondary sensoria transverse, more or less narrow. Hairs minute and not capitate on apterae. (Page 904)..... **Euceraphis**

[Genus **Callipterinola** Strand n. n.]

(Strand, Arb. aus Syst. Zool. Inst. Lettlaend Univ. No. 27, p. 47, 1928.)

[(Synonym *Callipterus* Koch.) Type, *Aphis juglandis* Frisch. (Synonym *Aphis juglandis* Goetz, 1778; *Lachnus juglandis* Kaltenbach)].

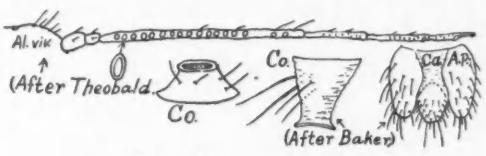

FIG. 56. *Callipterinola juglandis.*

Characters.—Antennæ much longer than body and bearing stout hairs; secondary sensoria oval. Cornicles truncate, bearing long hairs. Cauda knobbed. Anal plate deeply bilobed. Fore wings with radial sector faint, other veins bordered with brown. Living on leaves.

Taxonomy.—*Aphis juglandis* Goetz, chosen by Passerini was the first type set and was included by Koch when he established

the genus. The designation is valid according to rule even though the choice may have been unfortunate as a representative of Koch's idea of the genus. *Callipterus* was pre-occupied by Agassiz in 1846. (See Takahashi, Pr. Ent. Soc. Wash., Vol. 32, No. 1, p. 3, 1930.) Not recorded in the state.

Genus **Myzocallis** Passerini.

Type, *Aphis coryli* Goetze. (Passerini, Gli Afidi, p. 28, 1860).

Characters.—Frontal tubercles indistinct. Antennæ with minute hairs; unguis longer than half base of VI; secondary sensoria usually absent in apteræ. Fore wings usually with radial sector faint. Media twice forked. Hairs capitate on body, conspicuous in apteræ, pointed and inconspicuous in alatæ. Cornicles short, truncate, and more or less widened at base. Eyes with ocular tubercles. Cauda knobbed. Anal plate bilobed, to divided. Rostrum moderately obtuse. Living on leaves.

Genotype, *Myzocallis coryli* (Goetz). (See below.)

KEY TO SPECIES OF MYZOCALLIS.

A. Without spine-like dorsal tubercles.
  B. Fore wings with dark bands. On *Quercus*.
    C. Cornicles dark. Unguis twice or more times base of VI; 6–10 sensoria on antennal joint III of alatae. (Page 889) ..... **discolor**
    CC. Cornicles pale. Unguis hardly twice base of VI; 3–6 sensoria on III. (Page 890) ..... **discolor** var. **coloradensis**
  BB. Fore wings hyaline.
    C. Unguis longer than base of VI.
      D. Unguis about three times base. Joint III of antennae of alate viviparae with about three sensoria. On *Corylus*. (Page 888) .. **coryli**
      DD. Unguis about twice base. Joint III of antennae of alatae with 6–10 sensoria. On *Quercus*. (Page 890) ..... **punctata**
    CC. Unguis not longer than base of VI.
      D. Diameter of cornicles at base at least twice that at tip. Body hairs of apterae not noticeably capitate. On *Tilia*. (Page 891) . **tiliae**
      DD. Diameter of cornicles but slightly dilated at base. Body hairs of apterae capitate.
        E. Cauda elongated. Antennae of apterae with secondary sensoria. On *Ononis* and *Trifolium*. (Page 892) ..... **trifolii**
        EE. Cauda globular; antennae of apterae without secondary sensoria. On *Robinia*. (Page 891) ..... **robiniae**
AA. With spine-like dorsal tubercles. On *Ulmus*. (Page 893) ..... **ulmifolii**

[Genotype **Myzocallis coryli** (Goetz).]

Goetze, Ent. Beitrage, Vol. 2, p. 311, 1778. *Aphis*.

Color.—Pale yellowish-green or white throughout, including nearly entire legs. Wings hyaline.

Measurements.—Alate vivipara.—Body 1 to 1.5 mm. long; hind tibiæ .8 to 1 mm.; hind tarsi .10 mm., first joint approximately triangular; antennæ 1.3 to 1.7 mm.; joint III .36 to .42 mm.; IV .26 mm.; V .20 to .23 mm.; VI .10 + .23 to .25 mm.; cornicles .04 to .065 mm.; cauda .05 mm. from constriction; .08 mm. from base. Apterous vivipara.—Unknown. Apterous ovipara.—Body 1.5 by .7 mm.; hind tibiæ .5 mm.,

proximal two-thirds swollen and bearing many sensoria; antennæ imbricated, .82 mm. long; joint III .20 to .26 mm.; IV .12 to .16 mm.; V .12 to .16 mm.; VI .09 + .20 mm.; cornicles .06 mm.

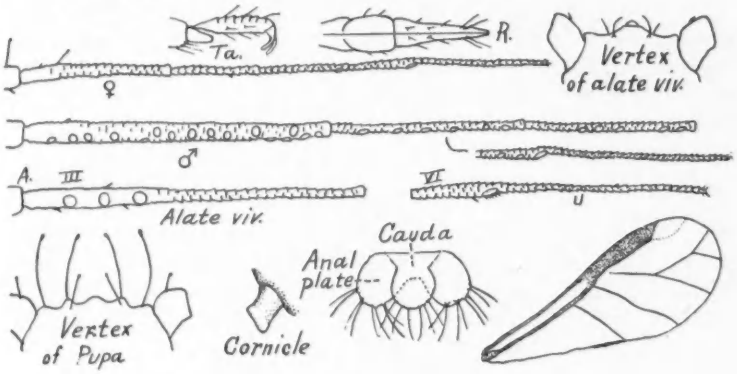

FIG. 57. *Myzocallis coryli.*

Structural Characters.—Secondary sensoria circular and large, 3 or 4 on III in alate viviparæ; absent in apteræ, vertex distinctly produced, especially in alatæ. Frontal tubercles lacking. Rostrum attaining second coxæ. Hairs in apteræ capitate, .07 to .15 mm. long on body; on antennæ minute or absent except proximally; on tibiæ pointed, .03 to .05 mm. long and sparse; on alatæ pointed, sparse, .02 to .03 mm. long, shorter distally on antennæ. Cauda knobbed. Anal plate bilobed except in oviparæ. Radial sector faint. Mediæ twice forked. Males alate.

Host.—Corylus sp. on leaves. Not recorded in the state.

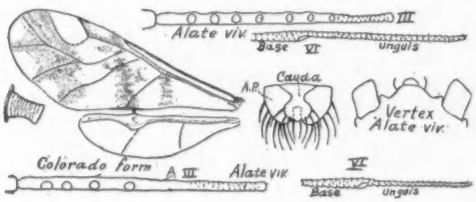

FIG. 58. *Myzocallis discolor.*

[Myzocallis discolor (Monell).]

Monell, Bul. U. S. Geol. & Geog. Surv. Terr., V, No. 1, p. 30, 1879. *Callipterus.*

Color.—In all forms.—Greenish or yellowish spotted with dusky; cornicles and area surrounding base dusky; fore wings with conspicuous dusky bands, radial cell clear.

Measurements.—Alate vivipara.—Body 1.5 to 2 mm.; hind tibiæ .9 to 1 mm.; antennæ 1.80 mm.; joint III .46 to .55 mm.; IV .30 to .40 mm.; V .24 to .34 mm.; VI .11 to .14 + .20 to .32 mm.; cornicles .06 mm. Rostrum as in type, attaining between first and second coxæ.

Structural Characters.—Radial sector very slightly fainter than other veins. Media twice forked. Vertex of alate vivipara produced. Secondary sensoria round, 6 to 10 in number on joint III of alate viviparæ; absent in apteræ. Unguis two to two and half times base of VI.

Host.—Leaves of *Quercus.* (Not taken in Colorado.)

[Data for above description taken from descriptions by J. Monell in correspondence, and A. C. Baker, (Jo. Ec. Ent., Vol. 10, p. 420, 1917) and amplified from specimens which agree with all characters mentioned in said descriptions.] Typical examples were taken in Michigan, at Lansing and at Detroit, and in Massachusetts at Webster, in June and July; alate viviparæ only.

Myzocallis discolor var. **coloradensis** n. var.

Color.—Same as above except cornicles pale.

Measurements.—Alate vivipara.—Body 1 to 2 mm.; hind tibiæ .7 to .9 mm.; antennæ 1.5 to 1.8 mm.; joint III .41 to .60 mm.; IV .30 to .53 mm.; V .28 to .38 mm.; VI .14 to .16 + .20 to .27 mm.; cornicles .05 mm. Apterous summer vivipara, unknown.

Structural Characters.—Secondary sensoria on antennal joint III of alate viviparæ number from 3 to 6 and the unguis is usually once and one half, rarely two times, base of VI. Sexuales similar to *M. coryli* Goetze in sensoria of antennæ. Males alate.

Collections.—On *Quercus alba* and *macrocarpa*, on leaves. Recorded in the state at Fort Collins, Manitou, Salida, and Ouray; alate viviparæ, June 15 to Oct. 23; sexuales, Sept. 27 to Oct. 23; 18 collections; common.

Taxonomy.—This variety shows paler cornicles, fewer sensoria and shorter unguis. These differences do not appear to be sufficient to be considered specific; indeed, Mr. Monell himself, in correspondence with the senior author, pronounced Colorado specimens sent him to be his *discolor*.

Myzocallis punctata (Monell).

Monell, Bul. U. S. Geol. & Geog. Surv. Terr. V, No. 1, p. 30, 1879. *Callipterus.*

Characters.—Similar to *M. discolor* Monell, especially the Colorado form, excepting that the banding of the wings is lacking, only the tips of the veins of fore wings being slightly smoky.

Collections.—On *Quercus alba, macrocarpa,* and sp., on leaves. Recorded in the state at Fort Collins and Manitou; alate viviparæ, May 25 to Oct. 20; sexuales, Oct. 18 to 20; 8 collections; fairly common.

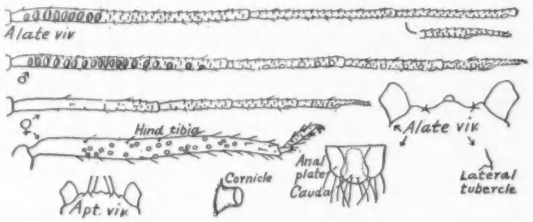

FIG. 59. *Myzocallis robiniae.*

Myzocallis robiniae (Gillette).

Gillette, Can. Ent. XXXIX, p. 395, 1907. *Callipterus.*

Color.—Yellow or greenish-yellow; alatæ with a pair of powdery lines extending from antennæ to tip of abdomen; sexuales with dark spots and dashes.

Measurements.—Alate vivipara.—Body 1.6 to 1.9 mm.; hind tibiæ 1 mm.; antennæ 1.6 mm.; joint III .50 to .60 mm.; IV .25 to .40 mm.; V .25 to .34 mm.; VI .13 + .07 to .10 mm. Apterous vivipara.—Unknown.

Structural Characters.—Frontal tubercles inconspicuous. Vertex convex. Secondary sensoria subcircular to oval, 8 to 11 in number on antennal joint III of alate viviparæ; absent in apteræ; forming a single row on joints III, IV, V, and VI of male. Cauda knobbed. Anal plate distinctly bilobed. Cornicles truncate with base slightly enlarged. Wings hyaline. Radial sector faint; media twice forked. Hairs inconspicuous in alatæ, except on cauda and anal plate; long and capitate in immature and apterous forms. Males alate.

Collections.—On leaves of *Robinia neomexicana* and *pseudoacacia.* Recorded in the state in Fort Collins, Boulder, Denver, Trinidad, Sugar City, and Grand Junction; alate viviparæ, June 10 to Oct. 2; and sexuales, Sept. 21 to Nov. 9; 29 collections; common.

Types in U. S. Nat. Mus., Cat. No. 41935; paratypes in collection of Colo. Agr. Exp. Sta.

[**Myzocallis tiliae** (Linnaeus).]

Linnaeus, Edition 10, Systema Naturae, p. 452, 1758. *Aphis.*

Color.—In all forms.—Yellow; alatæ with black lateral vittæ on head and thorax, continued by broken black bands on abdomen;

antennæ banded. Fore wings with anterior margin and tips of veins smoky, median and anterior portion of stigma paler; legs mostly pale; cornicles slightly dusky; cauda yellow.

Measurements.—Alate vivipara.—Body 2 mm. long; hind tibiæ .9 mm.; hind tarsi .15 mm.; antennæ 2 to 2.19 mm.; joint III .64 to .74 mm.; IV .41 to .49 mm.; V .37 to .45 mm.; VI .26 to .32 + .195 to .245 mm.; cornicles .057 mm.; cauda .145 mm. entire length, .09 mm. from neck. Apterous viviparæ.—Unknown.

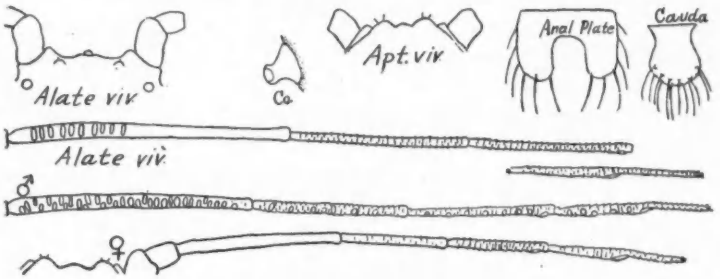

FIG. 60. *Myzocallis tiliae.*

Structural Characters.—Frontal tubercles slightly developed. Vertex with a pair of tubercles close to anterior margin, each with one or two hairs. Antennæ distinctly annulated. Secondary sensoria oval, transverse, 10 to 17 in number on antennal joint III of alate viviparæ; absent on apteræ. Cornicles truncate with base enlarged to twice diameter of tip. Cauda knob-like with slight neck. Anal plate decidedly bifid. Male alate with oval sensoria on all joints of antennæ, including VI. Hairs in both alatæ and apteræ pointed, inconspicuous, .01 to .02 mm. long on antennæ and body, longer on cauda and anal plate.

Host.—Leaves of *Tilia*. Not recorded from the state.

[Data from Davis, (Ann. Ent. Soc. Amer., p. 33, 1909) amplified from specimens determined by A. A. Granovsky collected in the eastern states.]

Taxonomy.—This species differs from the type in the absence of secondary sensoria on the antennæ and inconspicuous hairs on body of apteræ, slight antennal tubercles and dilated cornicle bases. It has been placed in several different genera by different authorities.

[Myzocallis trifolii (Monell).]

Monell, Can. Ent. XIV, p. 14, 1882. *Callipterus.*

Color.—In viviparæ.—Greenish-yellow with dusky tubercles on dorsum; legs mostly pale; wings hyaline with veins narrowly bordered and tipped with brownish.

Measurements.—Alate vivipara.—Body 1.4 to 1.6 mm. long; hind tibiæ .8 mm.; hind tarsi .13 mm.; antennæ 1.66 mm.; joint III .49 to .54 mm.; IV .36 to .39 mm.; V .30 to .35 mm.; VI .15 to .18 + .15 to .18 mm.; cornicles .066 mm.; cauda .14 mm. entire length, .09 mm. from neck. Apterous summer vivipara.—Same as alata.

Structural Characters.—Secondary sensoria oval to elongate, transverse, with rather broad margins, 10 to 12 in a single row on proximal half of III in both alate and apterous viviparæ as well as oviparæ. Antennæ imbricated. Cauda elongate, knobbed but with tip upturned. Anal plate decidedly bifid, except in oviparæ where it is entire. Rostrum not attaining second coxæ. Frontal tubercles slightly developed. Vertex slightly produced. Hairs inconspicuous in alatæ; .07 mm. long and capitate in apteræ. Males alate.

FIG. 61. *Myzocallis trifolii.*

Host.—Trifolium pratense on undersides of leaves. Not recorded in the state.

Taxonomy.—Theobald, (Aphid Gr. Brit., Vol. 2, 1927) considers this species as a synonym of *ononidis* Kaltenbach. The genus *Therioaphis* has been erected for this form but the writers do not consider these characters to represent a true generic complex.

Myzocallis ulmifolii (Monell).

Monell, Bul. U. S. Geol. & Geog. Surv. Terr., V, No. 1, p. 29, 1879. *Callipterus.*

Color.—In all forms.—Pale yellow to greenish, alate viviparæ with dusky vittæ on head and pronotum and speckles on abdomen; legs pale; wings hyaline.

Measurements.—Alate vivipara.—Body 1.5 to 1.7 mm.; hind tibiæ .70 to .80 mm.; hind tarsi .11 mm.; antennæ 1.45 to 1.55 mm.; joint III .50 to .52 mm.; IV .30 to .33 mm.; V .27 to .30 mm.; VI .12 to .15 + .13 mm.; cornicles .02 mm. long. Cauda .05 mm. from neck, .09 mm. entire length. Apterous summer vivipara.—Unknown.

Structural Characters.—Vertex produced. Frontal tubercles but slightly developed. Secondary sensoria transverse, elongate, 6 to 10 on basal half of joint III of alate viviparæ; absent in apteræ. Hairs in alatæ minute; in apteræ, capitate and .08 to .10 mm. long on body; minute on antennæ. Cauda knobbed. Anal plate bilobed. Cornicles obliquely truncated. Rostrum obtuse, hardly attaining second coxæ.

Radial sector faint. Media twice forked. Alate viviparæ with two pairs of finger-like dorsal tubercles on first and second abdominal segments and smaller ones on succeeding segments. Oviparæ with hind tibiæ considerably swollen along almost entire length and bearing numerous sensoria. Males alate.

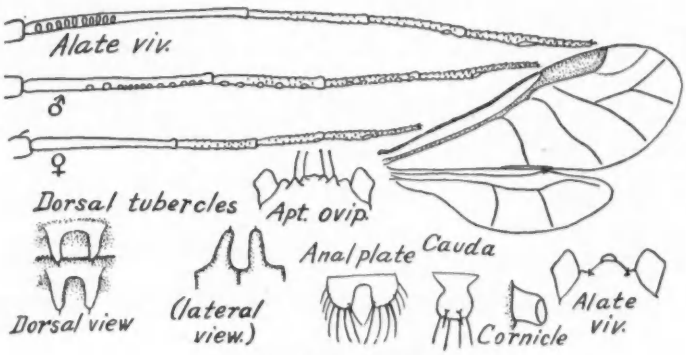

FIG. 62. *Myzocallis ulmifolii.*

Collections.—On leaves of *Ulmus americana.* Recorded in the state at Fort Collins, Boulder, Denver and La Junta; alate viviparæ, July 28 to Oct. 7; sexuales, Sept. 3 to Oct. 23; 21 collections; abundant at times.

Taxonomy.—This species resembles very closely *Myzocallis pulchellus* Glendenning (1929, Can. Ent., Vol. 61, p. 237) but differs in the longer unguis and fewer sensoria. *M. pulchellus* has unguis hardly as long as half of base and 18 to 25 sensoria on antennal joint III of alate viviparæ.

Genus **Monellia** Oestlund.

Type, *Aphis caryella* Fitch. (Oestlund, Geol. & Nat. Hist. Survey, Minn., Bul. No. 4, p. 44, 1887.)

Characters.—Frontal tubercles lacking. Antennæ without prominent hairs; unguis not longer than base of VI; secondary sensoria elongate-oval. Cornicles mere pores. Cauda knobbed. Anal plate distinctly bilobed. Hairs on body inconspicuous in alatæ; long and capitate in apteræ and nymphs. Differs from *Myzocallis* only in character of cornicles. Living on leaves of trees.

Type species not described here on account of uncertainty as to exact identity.

Monellia caryae (Monell).

Monell, Bul. U. S. Geol. & Geog. Surv. Terr. V, No. 1, p. 31, 1879. *Callipterus.*

Color.—Viviparæ.—Pale yellow without markings; legs pale, antennæ banded, wings hyaline; stigma pale yellow; males with dusky bands on abdomen; oviparæ speckled.

Measurements.—Alate vivipara.—Body 1.3 to 1.5 mm.; hind tibiæ .80 mm.; hind tarsi .10 mm.; antennæ 1 to 1.2 mm.; joint III .32 to .41 mm.; IV .23 to .27 mm.; V .18 to .24 mm.; VI .13 to .16 + .12 to .15 mm.; cauda .10 mm. entire length; .05 mm. from neck. Apterous viviparæ not found.

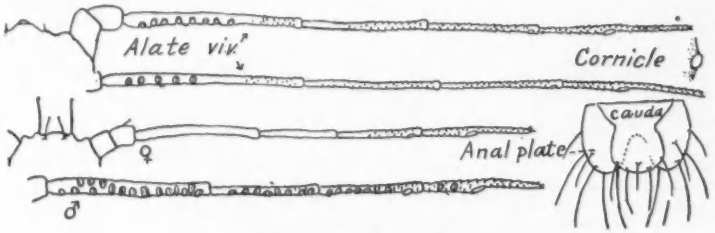

FIG. 63. *Monellia caryae.*

Structural Characters.—Vertex slightly produced. Frontal tubercles not developed. Cornicles mere pores. Cauda knobbed, with slight neck. Anal plate bilobed. Hairs pointed and inconspicuous in alatæ; capitate and .09 mm. long on body of apteræ and nymphs. Rostrum obtuse, attaining about to second coxæ. Secondary sensoria oval to transverse, absent on antennæ of apterous oviparæ; 6 to 10 in a row in alate viviparæ on basal half to two-thirds of joint III, which portion is not noticeably thickened. Mediæ twice forked; radial sector faint. Males alate.

Collections.—On leaves of *Carya* and *Juglans* sp. Recorded in Colorado on leaves of *Juglans regia*, near Fort Collins, Boulder, and Denver; alate viviparæ, June 10 to Sept. 4; sexuales, Sept. 24 to Oct. 18; twelve collections; rather common where host occurs.

Genus **Symydobius** Mordvilko.

Type, *Aphis oblonga* Heyden. (Mordvilko, Varshava Universitetskiia Izviestiia, Vol. 8, No. 58, p. 65, 1894).

Characters.—Frontal tubercles slightly developed. Antennæ with inconspicuous hairs; unguis not longer than base of VI. Secondary and primary sensoria, oval to circular; present in apteræ. Hairs on body somewhat spine-like. Imbrications on antennæ and cornicles minutely setose. Cornicles truncate, somewhat broader at base and with flange. Cauda semi-circular, broader than long. Anal plate entire or slightly indented. Living on bark of twigs of trees.

[Genotype **Symydobius oblongus** (Heyden).]

Heyden, Ent. Beitr. Musc. Senk., Vol. 2, p. 298, 1837. . *Aphis.*

Color.—In all forms.—Brown; veins of fore wings heavily shadowed, not smoky at tips. Antennæ annulated.

Measurements.—Alate vivipara.—Antennal joint III 1.12 mm.; IV .72 mm.; V .528 mm.; VI .208 + .112 mm. Apterous viviparæ.—Body 3.25 to 3.50 mm.; antennal joint III 1.16 mm.; IV .72 mm.; V .51 mm.; VI .144 + .112 mm.

Structural Characters.—Secondary sensoria covering only basal half of antennal joint III; present in male on joints III and V. Cauda semi-circular. Anal plate entire. Imbrications on antennæ and cornicles minutely setose. Males apterous.

Host.—Bark of older twigs of *Betula alba.* (Data from Baker Can. Ent., Vol. 50, p. 318, 1918 amplified from specimens received from P. Van der Goot.) Not recorded from the state.

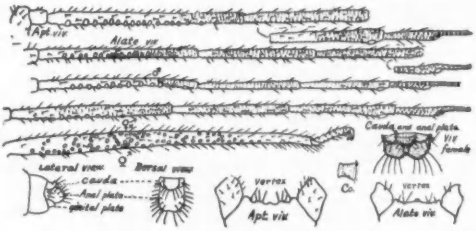

FIG. 64. *Symydobius intermedius.*

Symydobius intermedius Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 23, p. 543, 1930.

Color.—In all forms.—Tawny-olive to greenish with dusky cross bands on abdomen, often coalescing; cornicles pale; antennæ annulated; legs dusky to black; fore wings with veins heavily bordered, the media and cubitus being the most broadly bordered.

Measurements.—Alate vivipara.—Body 2 mm.; hind tibiæ 1.4 mm.; antennæ 2.4 mm.; joint III .64 to .88 mm.; IV .47 to .60 mm.; V .44 to .52 mm.; VI .16 to .27 + .10 to .14 mm.; cornicles .07 mm.; cauda .05 mm. Apterous summer vivipara.—Same as alata to slightly larger.

Structural Characters.—Rostrum obtuse, attaining second coxæ. Vertex but slightly convex. Frontal tubercles slightly developed in apteræ, hardly noticeable in alatæ. Secondary sensoria circular to oval, arranged in single row, extending along entire length of antennal joint III, 12 to 22 in number in all forms; sensoriation in males same as in females. Cauda, semilunar to wart-like. Anal plate indented and bearing two lobe-like swellings at base, one on either side of cauda.

Hairs on cauda, numerous, bushy; on antennæ spine-like but inconspicuous; on body moderately conspicuous, .03 to .04 mm. long. Males apterous.

Collections.—On bark of twigs of *Betula fontinalis* and *Betula* sp. Recorded in Colorado at Fort Collins, Boulder, Estes Park, Stove Prairie (near Bellvue) and Crawford; fundatrices, April 7; apterous summer viviparæ, June 2 to Oct. 7, alate viviparæ, June 2 to Aug. 9, apterous oviparæ, Sept. 25 to Oct. 13, apterous males, Oct. 15; twenty collections; fairly common.

Taxonomy.—This species is distinguished from *S. oblongus* (Heyden) by the indented anal plate, the distribution of secondary sensoria along entire joint, and the absence of sensoria on antennal joint V in male. From *S. americanus* Baker it is separated by the shorter unguis, equal to base of VI in *americanus*.

Types in the U. S. Nat. Mus., Cat. No. 42819; paratypes in collection of Colo. Agr. Exp. Sta.

[Genus **Chromaphis** Walker.]*

Type, *Lachnus juglandicola* Kaltenbach. (Walker, The Zoologist, Vol. 5, p. 2001, 1870).

Characters.—Frontal tubercles inconspicuous. Antennæ shorter than body; unguis much shorter than base of VI. Cornicles truncate. Cauda globular. Anal plate emarginate. Hairs on antennæ minute; on body of oviparæ and young, moderately long and capitate. Living on leaves and twigs of trees.

[Genotype **Chromaphis juglandicola** (Kalt.).]

Kaltenbach, Mon. der Pflanzenlause, p. 151, 1843. *Lachnus.*

Color.—In all forms.—Pale lemon-yellow to salmon-pink to brownish; legs pale with dusky spot distally on femur; stigma pale, cornicles and cauda pale. Wings hyaline.

Measurements.—Alate vivipara.—Body 1.6 to 2.5 mm.; hind tibiæ .65 to .70 mm.; hind tarsi .10 mm.; antennæ .77 to 1 mm.; joint III .26 to .40 mm.; IV .15 to .23 mm.; V .13 to .19 mm.; VI .08 + .03 to .04 mm.; cornicles .04 to .05 mm., about as wide as long; cauda .056 mm. Apterous vivipara.—Unknown.

Structural Characters.—Vertex convex. Frontal tubercles, undeveloped. Hairs pointed and short in alatæ, long and capitate in apteræ.

*Borner (Arch. Klass. Phylog. Ent., Bd. I, Heft. 2, p. 162, 1930) considers *Chromaphis* to replace *Callipterus* and holds the erection of *Callipterinola* as unnecessary.

Secondary sensoria on antennæ oval, transverse, 6 to 8 scattered in single row along entire length of joint III in alate viviparæ, absent in apteræ. Cornicles truncate, tapering, with occasional hairs. Radial sector faint, especially at base; media twice forked. Rostrum obtuse, attaining between first and second coxæ. Fundatrices and males alate, oviparæ apterous.

Host.—Leaves of *Juglans* sp. Not recorded from the state, but likely to occur.

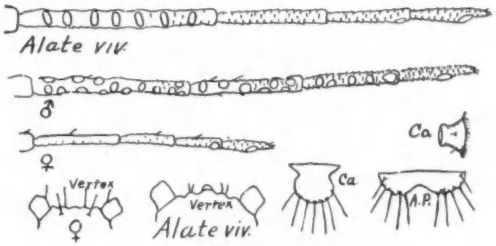

FIG. 65. *Chromaphis juglandicola.*

Genus **Cepegillettea** Granovsky.

Type, *Cepegillettea betulaefoliae* Granovsky. (Granovsky, Proc. Ent. Soc. Wash., Vol. 30, p. 113, 1928).

Characters.—Frontal tubercles prominent; joint I of antennæ macrosiphum-like. Vertex and antennæ with short capitate hairs; alike in alatæ and apteræ. Antennal joint III with secondary sensoria in all forms; permanent sensorium at base of unguis long, oval, without noticeable cilia. Antennæ longer than body; unguis longer than base of VI. Cornicles short, truncate, imbricated. Cauda spatulate, long, with evident neck and long basal portion; tip Calaphis-like. Anal plate moderately cleft. Fore wings, with veins heavy and somewhat bordered, at least smoky at tip. Radial sector present or absent. Living on leaves of trees.

Genotype **Cepegillettea betulaefoliae** Granovsky.

Granovsky, A. A.; Proc. Ent. Soc. of Wash., Vol. 30, p. 115, 1928.

Color.—In all forms.—Yellowish-green; with head and thorax of alatæ yellow-brown; antennæ annulated with black; legs pale; stigmæ yellow.

Measurements.—Alate vivipara.—Body 2.5 mm. to base of cauda; antennæ 5.22 mm.; joint III 1.50 mm.; IV 1.30 mm.; V 1.04 mm.; VI .32 + .60 mm.; cornicles .16 mm.; cauda .38 mm. entire length, .19 mm. from neck. Apterous vivipara.—About the same as alata.

Structural Characters.—Antennæ minutely imbricated. Secondary sensoria oval on antennal joint III, from 13 to 20 in alatæ, and 10 to 15 in apteræ. Rostrum attaining second coxæ. Mediæ twice forked. Males alate. Other characters as in description for genus.

Collections.—On leaves of *Betula*. Recorded from Fort Collins, Colorado; alate and apterous viviparæ; one collection; Aug. 18; rare.

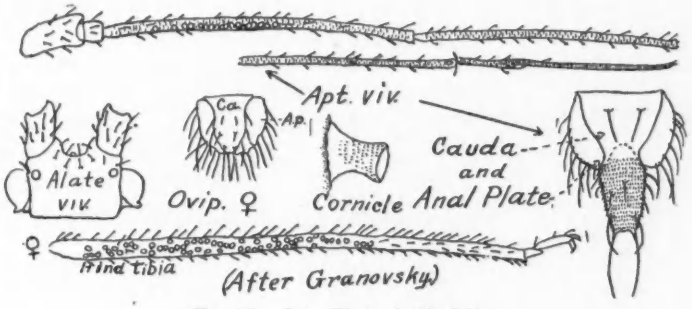

FIG. 66. *Cepegillettea betulaefoliae.*

Genus **Calaphis** Walsh.

Type, *Calaphis betulella* Walsh. (Walsh, Proc. Ent. Soc. Phila., Vol. 1, p. 301, 1863).

Characters.—Frontal tubercles well developed. Vertex not produced. Hairs on vertex and body, capitate and long in apteræ, and nymphs, short and blunt in alatæ. Antennæ longer than the body, with minute spine-like hairs; unguis much longer than base; secondary sensoria sub-circular to circular. Wing veins somewhat smoky; radial sector faint or absent. Cornicles short, somewhat broader at base. Cauda knobbed. Anal plate bilobed in viviparæ. Both cauda and anal plate with numerous stout hairs. Antennæ of apteræ, both viviparæ and oviparæ, with secondary sensoria. Permanent sensorium at base of unguis long-oval and with cilia. Living on leaves of trees, more or less solitary.

Genotype, *Calaphis betulella* Walsh. (See below.)

KEY TO SPECIES OF CALAPHIS.

A. Without dusky markings in viviparae. (Page 901).....**betulaecolens**
AA. With distinct dusky markings.
B. With conspicuous vittae in alatae. Hairs capitate and long in apterae, pointed and minute in alatae. (Page 900).....**betulella**
BB. Without vittae but with dusky bands on all segments in both alate and apterae. Hairs pointed and conspicuous in both alatae and apterae. (Page 901).....**annulata**

[Genotype **Calaphis betulella** Walsh.]

Walsh, Proc. Ent. Soc. Phil., I, p. 301, 1863.

Color.—Yellowish in alate viviparæ, with three black vittæ over head and thorax, and black bands bordering anterior and posterior margins of abdominal segments, 2 to 6 in alate vivipara; nymphs and apteræ speckled with dusky; femora pale with black vittæ and fasciæ; tibiæ and tarsi black; stigmæ and veins narrowly margined with black, and smoky at tips.

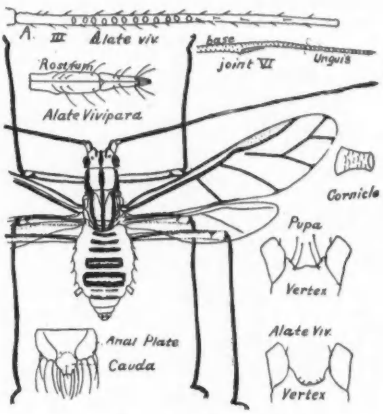

FIG. 67. *Calaphis betulella.*

Measurements.—Alate vivipara.—Body 2 to 2.5 mm.; hind tibiæ 2 to 2.25 mm.; hind tarsi .15 mm.; antennæ 3.6 to 4 mm.; joint III 1.25 to 1.35 mm.; IV .85 to .90 mm.; V .60 to .70 mm.; VI, .25 to .30 + .45 to .53 mm.; cornicles, .10 mm.; cauda .15 mm. entire length, .06 mm. from neck. Apterous vivipara.—Same as alata.

Structural Characters.—Secondary sensoria oval, transverse, in single row on proximal two-thirds of joint III, 10 to 17 in number, absent on other joints. Vertex concave. Frontal tubercles strongly developed, diverging. Cornicles obliquely truncate, faintly imbricated, slightly broader at base. Anal plate bilobed in viviparæ. Hairs pointed, .03 to .05 mm. long on body and legs in alatæ; in nymphs and apteræ, capitate, .10 to .12 mm. long on body. Radial sector obsolete. Media twice forked.

Host.—Leaves of *Betula* sp. Not yet recorded from the state, but likely to occur.

Calaphis betulaecolens (Fitch).

Fitch, Rept. Reg. Univ. State N. Y. Cab. Nat. Hist., p. 66, 1851. *Aphis.*

Color.—In all forms.—Whitish to yellowish tinged with green or red; without black markings, except in sexuales; legs pale with customary dusky markings. Fore wings with veins narrowly bordered and tipped with dusky; radial sector usually obsolete at base, sometimes invisible throughout.

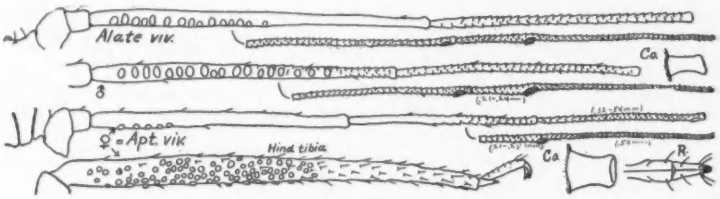

FIG. 68. *Calaphis betulaecolens.*

Measurements.—Alate vivipara.—Body 2 to 2.5 mm.; hind tibiæ 2 to 2.40 mm.; hind tarsi .13 to .15 mm.; antennæ 4.50 mm.; joint III 1 to 1.40 mm.; IV .83 to .93 mm.; V .70 to .75 mm.; VI .28 to .33 + .70 to .75 mm.; cornicles .11 mm. Apterous summer vivipara.—Same as alate vivipara or slightly smaller.

Structural Characters.—Vertex not produced. Frontal tubercles moderately developed. Secondary sensoria oval, transverse, 8 to 14 on proximal two-thirds of III in alate viviparæ; 4 to 6 on III in apteræ. Cauda and anal plate as in *betulella*. Rostrum attaining between second and third coxæ. Hairs pointed and .02 to .03 mm. on body; .05 mm. on hind tibiæ in alatæ; capitate and .10 to .12 mm. on body of apteræ. Radial sector usually evident at least distally. Mediæ twice forked. Fundatrices apterous.

Collections.—On *Betula fontinalis* and *alba* and *Alnus tenuifolia*, on leaves. Recorded from the state at Fort Collins, Boulder, Denver and Manitou; fundatrices, May 26 and 31; apterous summer viviparæ, June 14 to July 26; alate viviparæ, June 19 to Oct. 16; sexuales, Oct. 10 to 25; 23 collections; rather common.

Calaphis annulata (Koch).

Koch, Die Pflanzenlause Aphiden, p. 7, 1854. *Chaitophorus.*

Color.—Greenish-yellow marked with brown on head and thorax and with dusky bands on abdominal segments in both alatæ and apteræ; legs dusky; wings hyaline with veins slightly bordered and tipped with dusky; stigma pale medially.

Measurements.—Alate vivipara.—Body 2 mm.; hind tibiæ .75 to .9 mm.; hind tarsi .12 mm.; antennæ 1.3 mm.; joint III .37 to .53 mm.; IV .19 to .31 mm.; V .17 to .23 mm.; VI .10 + .21 to .24 mm.; cornicles .06 to .07 mm.; cauda .09 mm. entire length, .06 mm. from neck. Apterous summer vivipara.—Same as alata.

Structural Characters.—Vertex produced. Frontal tubercles developed, equal with vertex. Secondary sensoria circular, in single row on proximal two-thirds of joint III, 4 to 8 in alate viviparæ; 2 to 5 in apteræ. Hairs pointed, curved, .10 to .15 mm. long on body; .05 mm. on hind tibiæ and .02 mm. on antennæ of apteræ; on alatæ usually slightly shorter. Cornicles truncate, with setose imbrications. Cauda wart-like. Anal plate indented. Rostrum obtuse, attaining second coxæ. Radial sector faint, especially proximally. Tubercles on lateral margins of all abdominal segments, a pair on occiput and on vertex in both alate and apterous viviparæ.

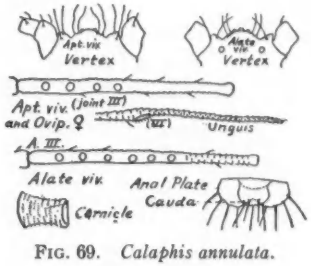

FIG. 69. *Calaphis annulata.*

Collections.—On *Betula alba*, on leaves. Recorded from the state at Fort Collins, Denver, Greeley and Boulder; apterous and alate summer viviparæ, July 8 to Sept. 26; oviparæ, Sept. 16; 6 collections; rather rare.

Genus **Oestlundiella** Granovsky.

Type, *Euceraphis flava* Davidson. (Granovsky, Proc. Ent. Soc. Wash., Vol. 32, p. 61, 1930).

Characters.—Frontal tubercles distinct. Antennæ longer than the body. Secondary sensoria subcircular, present on joint III of both alatæ and apteræ. Cornicles truncate with enlarged distal end and with distinctly mammiform base. Cauda rather elongated, with slight neck. Anal plate with shallow U-shaped cleft. Hairs inconspicuous on antennæ and body, blunt or slightly capitate. Body somewhat woolly. Radial sector evident. Media twice forked. Living on leaves and twigs of trees.

Genotype **Oestlundiella flava** (Davidson).

Davidson, Jo. Ec. Ent., Vol. 5, p. 406, 1912. *Euceraphis.*

Color.—In all forms.—Pale yellow; with cornicles and a pair of dorso-lateral vittæ on thorax of alate viviparæ and two pairs of longitudinal rows of spots on dorsum of oviparæ dark brown; antennæ annulated; cornicles black; wings hyaline; stigma pale. Alate viviparæ, more or less woolly; oviparæ with tufts of threads on venter of abdominal segments 5 and 6.

Measurements.—Alate vivipara.—Body 3.3 mm.; hind tibiæ 3 to 3.2 mm.; hind tarsi .20 mm.; antennæ 4 mm.; joint III 1.05 to 1.26 mm.; IV .73 to .88 mm.; V .60 to .70 mm.; VI .30 to .35 + .25 to .27 mm.; cornicles .10 mm. long, .16 mm. in diameter at base; cauda .15 mm. entire length, .10 mm. from neck.

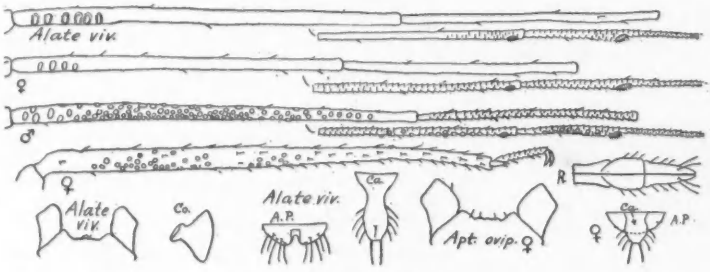

FIG. 70. *Oestlundiella flava.*

Structural Characters.—Frontal tubercles well developed. Vertex concave. Secondary sensoria on antennæ, oval, transverse, present on joint III in both alate viviparæ and apterous oviparæ, 2 to 7, rarely 10 in number. Hairs on both antennæ and body, in all forms, inconspicuous, very slightly capitate in apteræ. Cornicles obliquely truncate distally, with enlarged tip and distinctly mammiform base, diameter at base more than twice that at tip. Cauda rather spatulate with slight neck. Anal plate with shallow U-shaped cleft. Rostrum obtuse, attaining between first and second coxæ. Oviparæ with tibiæ slightly swollen. Males alate.

Collections.—On leaves of *Alnus rhombifolia* and sp. Recorded from northern part of the state on the eastern slope of the Rockies; alate viviparæ, June 7 to Oct. 13; sexuales, Oct. 11 and 13; 7 collections; rather rare.

Genus **Euceraphis** Walker.

Type, *Callipterus betulae* Koch. (Walker, The Zoologist, p. 2001, 1870).

Characters.—Frontal tubercles well developed. Antennæ longer than the body; unguis not longer than base of VI; secondary sensoria on antennal joint III, narrow, transverse, located near base, present in alatæ only; permanent sensorium on VI long, oval, and fringed. Cornicles truncate. Cauda somewhat knobbed. Anal plate entire or slightly emarginate. Wax glands often present in alatæ. Hairs not capitate; minute on body of alatæ and on antennæ of all forms. Radial sector distinct. Oviparæ producing many eggs. Living on leaves and twigs of trees, usually solitary.

Genotype, *Euceraphis betulæ* (Koch). (See below.)

KEY TO SPECIES OF EUCERAPHIS.

A. Joint III of antennae of alate viviparae with sensoria crowded. Unguis subequal with base of VI. On *Betula*. (Page 904) ..... **betulae**

AA. Joint III of antennae of alate viviparae with sensoria not crowded. Unguis shorter than base of VI. On *Alnus* and *Betula*. (Page 904) **gillettei**

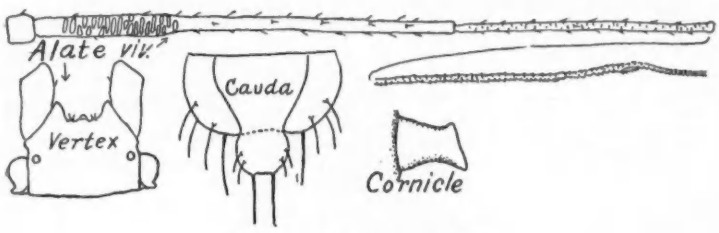

FIG. 71. *Euceraphis betulae.*

[Genotype **Euceraphis betulae** (Koch).]

Koch, Die Pflanzenlause Aphiden, p. 217, 1855. *Callipterus.*

Descriptions of this species by different writers vary somewhat, especially as to color markings. Van der Goot considers several varieties. As the authors do not have access to any authoritative specimens and the species does not seem to occur in Colorado, a detailed specific description will not be attempted here.

Euceraphis gillettei Davidson.

Davidson, Jour. Econ. Ent., VIII, p. 421, 1915.

Color.—Thorax pale brownish, abdomen pale apple green to yellowish without marking in alate viviparæ; dark dashes on abdomen in sexuales, oviparæ brownish. Alate viviparæ usually with flocculence.

Measurements.—Alate summer vivipara.—Body 2.5 to 3.5 mm.; hind tibiæ 2.9 mm.; antennæ 5.2 mm.; joint III 1.9 mm.; IV 1.25 mm.; V 1 to 1.1 mm.; VI .37 to .40 + .24 to .30 mm.; cornicles .11 mm.; cauda .13 mm. entire length, .10 mm. from neck. Apterous viviparæ, unknown.

Structural Characters.—Vertex concave. Frontal tubercles well developed. Secondary sensoria narrow, transverse, about 13 to 16 in single row on swollen proximal .3 to .5 of joint III in alate viviparæ; absent in apteræ. Alate viviparæ with two pairs of wart-like to finger-like dorsal tubercles. Other characters as in description for genus. Fundatrices and males alate. Oviparæ apterous.

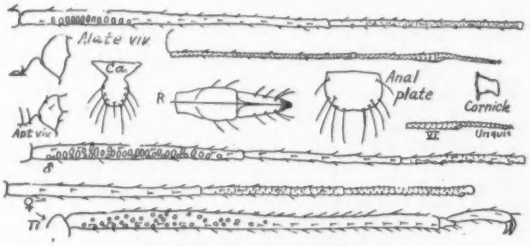

FIG. 72. *Euceraphis gillettei.*

Collections.—On leaves and tender twigs of *Alnus tenuifolia* and *Betula fontinalis.* Recorded in the state throughout the eastern slope of the Rocky Mountains and at Cedaredge on the western slope; alate viviparæ, May 29 to Aug. 22; sexuales, Sept. 29, to Oct. 20; twenty-nine collections; common.

Taxonomy.—This species may be a variety of *E. betulæ* (Koch) as that species appears to be quite variable and authorities appear to differ as to characters. *E. gillettei* is distinguished by fewer antennal sensoria and a shorter unguis, always shorter than base of VI. In *E. betulæ* the unguis is subequal with base of VI.

Subtribe **Saltusaphidina.**

Characters.—Ocular tubercles lacking. Body narrow. Cauda knobbed. Anal plate bilobed. Imbrications on antennæ setose. Fore wings with radial sector curved. Hind wings with cubitus obsolete. Rostrum obtuse, very broad, terminal joint obsolete.

KEY TO GENERA OF SALTUSAPHIDINA.

A. Body hairs flabellate.
B. Terminal tergite bifid, bearing cylindrical hairs. (Page 906)... **Saltusaphis**
BB. Terminal tergite not bifid, bearing flabellate hairs. (Page 907).... **Iziphya**
AA. Body hairs pointed. (Page 909)..... **Thripsaphis**

[Genus **Saltusaphis** Theobald.]

Type, *Saltusaphis scirpus* Theobald. (Theobald, Bul. Ent. Research, Vol. 6, pt. 2, p. 138, 1915).

Characters.—Head long and broad. Body narrow, hardly wider than thorax. Antennæ 6-jointed. Legs short; first and second femora thickened. Frontal tubercles and ocular tubercles lacking. Eighth tergite bilobed. Cauda knobbed. Anal plate bilobed. Hairs on body, flabellate; on eighth tergite cylindrical. Cornicles truncate on flat base. Mediæ twice forked. Hind wings without cubitus. Imbrications setose on antennæ, cornicles and cauda. Living on leaves of *Cyperaceæ*.

[Genotype **Saltusaphis scirpus** Theobald.]

Theobald, Bul. Ent. Research, VI, p. 138, 1915.

Color.—In all forms.—Yellowish; with dusky vittæ on head and speckles on abdomen in apteræ; dashes in alatæ; legs mostly yellowish; wing veins bordered and tipped with smoky; cornicles dusky.

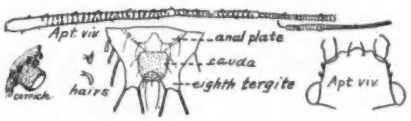

FIG. 73. *Saltusaphis scirpus.*

Measurements.—Apterous vivipara.—Body 2 to 2.5 mm.; abdomen hardly broader than thorax; hind tibiæ .65 mm.; hind tarsi .15 mm.; antennæ, 2 mm.; joint III .65 mm.; IV .31 to .35 mm.; V .26 to .29 mm.; VI .14 + .25 to .30 mm.; cornicles .03 to .04 mm.

Structural Characters.—Rostrum obtuse, attaining between first and second coxæ. Antennæ with minute hairs and setose imbrications. Secondary sensoria circular, 15 to 17 in single row on proximal .6 of joint III in alate viviparæ; absent in apteræ. Vertex very slightly convex. Frontal tubercles lacking. Cornicles truncate, on dusky area, surface setulose. Eighth tergite of abdomen bifid, projecting over cauda.* Cauda knobbed. Anal plate bilobed. Hairs flabellate on body, except on vertex, eighth tergite, cauda, and anal plate. Mediæ twice forked. Hind wing with cubital vein obsolete.

Host.—Leaves of *Scirpus* sp. With jumping habits. (Data from description by Theobald and from paratypes sent by him.) Not recorded from the state.

*Theobald mistook eighth tergite for cauda.

Genus **Iziphya** Nevsky.

Type, *Iziphya maculata* Nevsky. (Nevsky, V. P., Uzbekistan Exp. Sta. Plant Protection, No. 16, p. 314, 1929.) (Syn. *Caricaphis* Borner. Arch. Klassif. Phylog. Ent., Bd. I, Heft. 2, p. 165, 1930.)

Characters.—Head and thorax elongated. Eyes without ocular tubercles. Hairs on body and head flabellate, arising from large tubercles. Cornicles truncate, on broad hairy cones. Cauda cordiform. Anal plate divided. Antennæ 6-jointed, with spine-like hairs. Eighth tergite not bilobed, but tuberculate.

Genotype, *Iziphya maculata* Nevsky. (See below.)

KEY TO SPECIES OF IZIPHYA.

A. Cornicles set on raised cones. (Page 907) ..... **maculata**
AA. Cornicles not set on raised cones. (Page 908) ..... **flabella**

[Genotype **Iziphya maculata** Nevsky.]

Nevsky, V. P., Uzbekistan Exp. Sta. Plant Protection, No. 16, p. 314, 1929.

Color.—In apterous vivipara.—Greenish-yellow, with dusky specks and blotches on dorsum, tending to form two vittæ, transverse band between cornicles and covering eighth tergite.

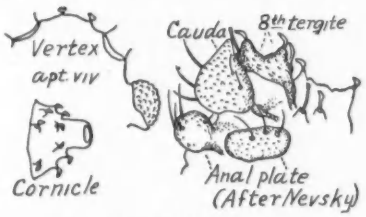

FIG. 74. *Iziphya maculata.*

Measurements.—Apterous vivipara.—Body 1.3 to 1.7 mm.; antennæ 1.4 mm.; joint III .40 mm.; IV .21 mm.; V .24 mm.; VI .14 + .26 mm.; cornicles cylindrical portion, .06 mm. long, .05 mm. wide; conical portion, .05 mm. long and .16 mm. in diameter at base; cauda .10 mm.; hairs .03 mm. long.

Structural Characters.—Head long. Vertex slightly convex. Hairs on body throughout, flabellate, set on large tubercles; on antennæ setigerous, on legs cylindrical or setigerous. Cornicles without flanges, truncate on raised conical base, which bears flabellate hairs. Cauda cordiform, pointed distally, bearing two or three pointed, curved hairs on each side. Anal plate divided. Eighth tergite somewhat covering cauda and bearing flabellate hairs on large tubercles.

Host.—*Cynodon dactylon*, on leaves. (Data from Nevsky 1929.) Not recorded in the state.

Iziphya flabella (Sanborn).

Sanborn, Kansas Aphididae, p. 37, 1904. *Chaitophorus.*
(Same as *Callipterus flabellus* Sanborn by Gillette, 1909, Ent. News, Vol. 20, p. 120).

Color.—In all forms.—Pale yellowish-green, with dusky specks and blotches tending to form vittæ and dorsal patches in alate and apterous viviparæ; femora dark; tibiæ pale; cornicles dusky; cauda pale; wing veins heavy, somewhat bordered and tipped with smoky.

Measurements.—Apterous summer vivipara.—Body 1.5 to 2 mm.; hind tibiæ .47 to .54 mm.; hind tarsi .14 mm.; antennæ 1.4 to 1.6 mm.; III .31 to .50 mm.; IV .17 to .26 mm.; V .20 to .24 mm.; VI .12 to .16 + .18 to .25 mm.; cornicles .04 mm.; cauda .12 mm. entire length, .07 mm. from neck. Alate vivipara.—Same as aptera.

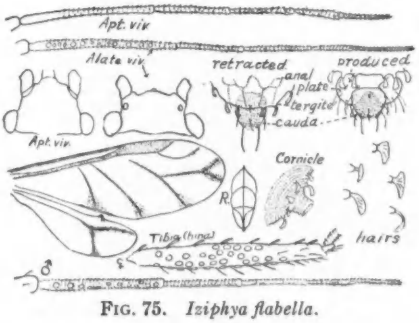

FIG. 75. *Iziphya flabella.*

Structural Characters.—Vertex strongly convex in apteræ, slightly convex in alatæ. Antennæ with imbrications setulose, without evident hairs. Secondary sensoria round, minute, 15 on basal three-quarters of joint III in alate viviparæ; present on all joints in males; absent in apteræ. Rostrum obtuse, barely surpassing first coxæ. Ocular tubercles lacking. Cornicles cylindrical, truncate on a circular base which bears flabellate hairs, entire surface setulose. Terminal tergite rounded, entire, hardly projecting over cauda. Cauda knobbed, distal end truncate or bluntly rounded. Anal plate bilobed. Hairs flabellate on small tubercles on body, excepting on vertex, cauda, anal plate, and inner side of tibiæ. Mediæ twice forked. Hind wings with cubital vein absent. Males apterous.

Collections.—On leaves of *Carex* sp. (small species on low meadows). With jumping habits. Recorded in the state at Fort Collins; fundatrices, April 28 and May 1; apterous summer viviparæ, May 2 to Sept. 28; alate viviparæ, April 28 to June 11, also Sept. 4; apterous oviparæ, Oct. 27; apterous males, Oct. 7 to 29; 31 collections; common.

Genus **Thripsaphis** Gillette.

Type, ***Brachycolus ballii*** Gillette. (Gillette, Can. Ent., Vol. 49, p. 193, 1917).

Characters.—Body very long, flat and slender. Ocular tubercles not evident. Antennæ much shorter than body, 6-jointed and with secondary sensoria round; permanent sensoria with cilia. Rostrum very broad and short. Cornicles mere rings on segment VI. Cauda knobbed. Anal plate divided in all forms. Body with spine-like hairs. Fore wings with mediæ usually twice branched, frequently deformed; hind wings with cubitus faint or absent. Living on leaves and stems of *Gramineæ* and *Cyperaceæ*.

Genotype, ***Thripsaphis ballii*** (Gillette). (See below.)

KEY TO SPECIES OF THRIPSAPHIS.

A. Vertex of apterae not with wart-like projection.
  B. Vertex of apterae moderately convex. Antennae of apterae without secondary sensoria. (Page 909) ..... **ballii**
  BB. Vertex of apterae strongly convex. Antennae of apterae with secondary sensoria. (Page 910) ..... **producta**
AA. Vertex of apterae with wart-like projection. (Page 911) ..... **verrucosa**

Genotype **Thripsaphis ballii** (Gillette).

Gillette, Can. Ent. XL, p. 67, 1908. *Brachycolus.*

Color.—Pale greenish, with dusky on head and thorax and cross bands and speckles on abdomen in all forms; slightly pulverulent; legs slightly dusky; oviparæ with tufts of secretion on venter of tip of abdomen.

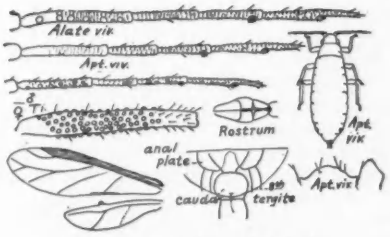

FIG. 76. *Thripsaphis ballii.*

Measurements.—Apterous vivipara.—Body 2 to 2.5 mm. by .75 to .80 mm., dorso-ventrally compressed, thrips-like; hind tibiæ .40 to .70 mm.; antennæ .80 mm.; joint III .19 to .26 mm.; IV .13 mm.; V .14 mm.; VI .14 + .09 mm.; cauda .09 mm. entire length, .04 to .05 mm. from neck. Alate vivipara.—Body 1.7 by .5 mm.; hind tibiæ .55 mm.; antennæ 1.05 mm.; joint III .31 to .40 mm.; IV .17 to .25 mm.; V .18 to .21 mm.; VI .14 to .16 + .09 to .12 mm.

Structural Characters.—Vertex rounded. Frontal tubercles not developed. Antennæ, imbricated. Body surface very minutely setose.

Secondary sensoria circular, large, in single row along entire length of joint III in alate viviparæ; absent in apteræ; present in male on antennal joints III, IV, V, and VI. Hairs spine-like, minute, about .10 mm. to .20 mm. long on antennæ and body. Cornicles mere pores on sixth abdominal segments. Rostrum very broad, barely surpassing first coxæ. Anal plate bilobed in all forms. Terminal abdominal tergite broadly rounded and projecting posteriorly, usually covering cauda. Males apterous.

Collections.—On leaves and stems of *Carex nebraskensis.* Recorded from Colorado at Fort Collins and Rocky Ford; fundatrices, April 27; apterous summer viviparae, April 29 to Sept. 17; alate viviparae, May 27 to July 13; oviparae, Oct. 30 to Nov. 9; males, Oct. 14 to 17; 31 collections; common.

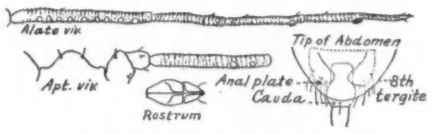

FIG. 77. *Thripsaphis producta.*

Thripsaphis producta Gillette.

Gillette, C. P., Can. Ent., Vol. 49, p. 196, 1917.

Color.—Blackish in viviparæ due to heavy banding and mottling; legs and antennæ black.

Measurements.—Apterous summer vivipara.—Body 2 by .7 mm.; hind tibiæ, .45 to .50 mm.; antennæ .95 mm.; joint III .26 to .30 mm.; IV .15 to .18 mm.; V .15 mm.; VI .13 + .08 mm.; cauda .06 mm. entire length, .04 mm. from neck. Alate vivipara.—About the same or with appendages slightly longer.

Structural Characters.—Vertex strongly convex, especially in apteræ. Frontal tubercles undeveloped. Secondary sensoria round, arranged in a single row on antennal joint III 9 to 11 in alate viviparæ; 1 to 3 in apterous viviparæ. Antennal imbrications minutely setose. Last dorsal tergite broadly rounded and extending more or less over cauda. Cornicles mere rings. Mediæ usually twice branched. Hind wings with cubital vein rather faint. Anal plate bilobed with rather broad U-shaped cleft. Cauda knobbed. Rostrum very broad, barely surpassing first coxæ.

Collections.—On leaves of *Carex nebraskensis.* Recorded in the state at Fort Collins; fundatrices (?), May 5 to 20; apterous summer viviparæ, June 20 to Aug. 17; alate viviparæ, June 3 to 20; 8 collections; common.

Taxonomy.—This species differs from *T. ballii* Gillette in the darker color, especially in the apteræ, presence of secondary

sensoria on antennæ of apteræ, greater number of sensoria on joint III of alatæ, more produced vertex in apteræ, and usually more U-shaped cleft in anal plate.

Thripsaphis verrucosa Gillette.

Gillette, Can. Ent., Vol. 49, p. 194, 1917.

Color.—Apteræ.—Pale greenish-yellow with slight dusky transverse dashes, appendages blackish; oviparæ with deep yellow spot just anterior to cornicles and same size as cornicle pores, and with wax threads projecting laterally from abdominal segments 6 and 7.

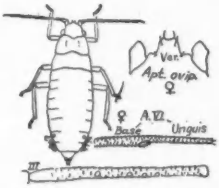

FIG. 78. *Thripsaphis verrucosa.*

Measurements.—Fundatrix.—Body 2 to 2.5 by .5 mm.; hind tibiæ .50 mm.; hind tarsi .14 mm.; antennæ .90 to 1.05 mm.; joint III .32 to .37 mm.; IV .14 to .17 mm.; V .14 to .17 mm.; VI .12 to .13 + .10 to .11 mm.; cauda .07 mm., .035 mm. from neck. Ovipara.—Body 2 to 3 by .96 mm.; hind tibiæ .75 to .80 mm.; hind tarsi .15 mm.; antennæ 1.60 to 1.80 mm.; joint III .55 to .60 mm.; IV .30 to .35 mm.; V .28 to .33 mm.; VI .15 to .18 + .20 mm.; cauda .15 mm.; from neck, .08 mm.

Structural Characters.—Vertex with wart-like projection .05 to .07 mm. long, as long as first antennal joint. Frontal tubercles absent. Secondary sensoria circular, in single row on distal half of joint III, 2 to 4 in number. Cornicles mere pores on middle of lateral portions of segment 6. Cauda knobbed. Anal plate divided. Antennæ with imbrications faintly setulose. Hind tibiæ in oviparæ slightly swollen and bearing numerous small, slightly convex sensoria. Hairs throughout very short and inconspicuous.

Collections.—On leaves of *Carex nebraskensis.* Taken in the state at Fort Collins; fundatrices, May 15; oviparæ, Oct. 15 to Dec. 2; 3 collections; rare.

Subtribe **Drepanosiphina.**

Characters.—Frontal tubercles developed. Antennæ much longer than body. Abdomen of oviparous females with segments posterior to cornicles elongated to form long ovipositor. Cauda knobbed. Anal plate indented. Cornicles much longer than broad. Mediæ twice forked.

KEY TO GENERA OF DREPANOSIPHINA.

A. Cornicles swollen at the base. (Page 912).....**Drepanaphis**
AA. Cornicles not swollen at the base. (Page 913).....**Drepanosiphum**

Genus **Drepanaphis** Del Guercio.

Type, *Siphonophora acerifolii* Thos. (Del Guercio, Rivista di Patologia, Vegetale, n. s., Vol. 4, No. 4, pp. 49–50, 1909).

Characters.—Frontal tubercles distinct. Antennæ bearing minute hairs. Secondary sensoria oval and ciliated. Conspicuous dorsal tubercles present. Cornicles more than twice as long as broad, swollen for proximal two-thirds. Cauda knobbed. Anal plate indented in viviparæ. Oviparæ with abdominal segments 7 and 8 greatly prolonged to form ovipositor. Living on leaves of trees.

Genotype **Drepanaphis acerifolii** (Thomas).

Thomas, Ill. State Lab. Nat. Hist., Bul. 2, p. 4, 1877. *Siphonophora.*

Color.—Olive-green, to pale sordid greenish or brownish in all forms; thoracic lobes brown in alatæ; cornicles pale greenish to brown; legs and antennæ sordid to greenish; male with black patch on dorsum of abdomen.

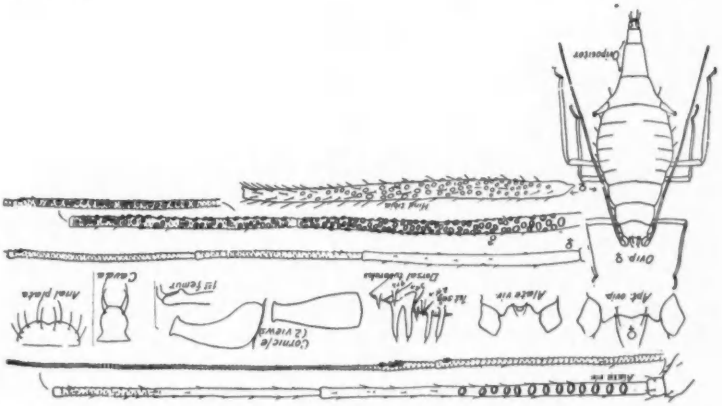

FIG. 79. *Drepanaphis acerifolii.*

Measurements.—Alate summer vivipara.—Body 2.3 to 2.5 mm.; hind tibiæ 1.3 to 1.4 mm.; hind tarsi .15 mm.; antennæ 3.5 to 3.75 mm.; joint III .82 to 1.05 mm.; IV .56 to .77 mm.; V .60 to .72 mm.; VI .13 to .15 + 1 to 1.5 mm.; cornicles .25 to .30 mm. long. Apterous viviparæ unknown.

Structural Characters.—Vertex slightly convex. Frontal tubercles distinctly developed. Cornicles with flanges, tapering, in one view

strongly swollen basally on posterior side, usually carried at right angles to body. Secondary sensoria large, oval, transverse, with cilia, arranged in a single row, 8 to 12 in number on basal .6 of joint III of alate viviparæ; absent in apteræ; numerous on all joints of male. Dorsum of alatæ with a pair of long finger-like tubercles on abdominal segments I and III, largest on III and slightly united at base, a pair of shorter ones on II and IV each. Hairs very inconspicuous in alatæ; rather long, .10 to .15 mm. in apteræ and slightly capitate; on antennæ, minute, about .01 mm. long. Fore wings with veins bordered with smoky, stigma dusky, with pale center. Rostrum obtuse, hardly attaining second coxæ. Fundatrices and males alate.

Collections.—On leaves of *Acer saccharinum*, solitary. Recorded from the state at Greeley, Boulder, Denver, and Fort Collins; fundatrices, May 12 to June 1; alate viviparæ, May 26 to Oct. 2; apterous viviparæ, unknown; apterous oviparæ, Sept. 30 to Nov. 7; males, Sept. 30 to Oct. 2; 50 collections; common.

Genus **Drepanosiphum** Koch.

Type, *Aphis platanoides* Schrank. (Koch, Die Pflanzenlause Aphiden, p. 201, 1855).

Characters.—Frontal tubercles distinct. Antennæ longer than the body, with minute hairs; unguis many times longer than base of VI. Secondary sensoria, large, oval and ciliated. Cornicles more than five times as long as wide, slightly swollen, smooth. Cauda knobbed. Anal plate indented in viviparæ. Oviparæ with terminal abdominal segments elongated to form ovipositor.

Genotype, *Drepanosiphum platanoides* (Schrank). (See below.)

KEY TO SPECIES OF DREPANOSIPHUM.

A. Cornicles swollen slightly in distal half. Oviparae without secondary sensoria. (Page 913) ..... **platanoides**

AA. Cornicles not swollen in distal half. Oviparae with secondary sensoria. (Page 914) ..... **braggii**

[Genotype **Drepanosiphum platanoides** (Schrank).]

Schrank, Fauna Boica, II, p. 112, 1801. *Aphis.*

Color.—Various shades of yellow or reddish to green with black markings and bands; legs and cornicles yellow to dusky orange. Wings hyaline.

Measurements.—Alate summer vivipara.—Body 2.7 to 3.5 mm.; hind tibiæ 2 to 2.25 mm.; hind tarsi .20 mm.; antennæ 5 mm.; joint III 1.3 to 1.6 mm.; IV .90 to 1.2 mm.; V .78 to .84 mm.; VI .14 + .80 to .96 mm.; cornicles .65 mm.

Structural Characters.—Vertex convex. Frontal tubercles distinctly developed. Secondary sensoria large, oval to narrow transverse, arranged in a single row, about 20 in number on proximal half of joint III in alate viviparæ; numerous on joints III, IV, and V, in male; absent

in oviparæ. Rostrum obtuse, hardly attaining second coxæ. Cornicles slightly swollen with narrow flange. Cauda elongate globular, knobbed, Anal plate indented in viviparæ. Hairs fine and pointed in alatæ; heavier, .12 mm. long, and slightly capitate in apteræ. Males alate. Oviparæ with tip of abdomen forming elongated ovipositor.

Hosts.—Leaves of *Acer platanoides, campestris* and *pseudoplatanus.* Not reported from the state.

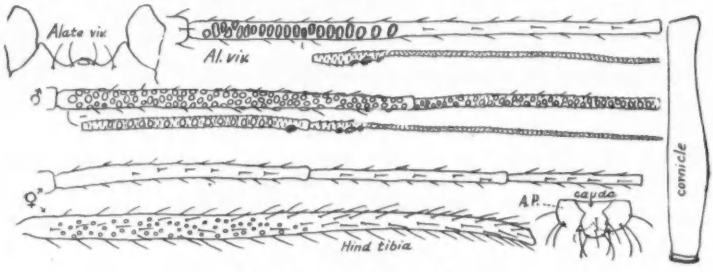

FIG. 80. *Drepanosiphum platanoides.*

Drepanosiphum braggii Gillette.

Gillette, Can. Ent., Vol. 39, p. 393, 1907.

Color.—In alatæ, pale yellow to greenish with black dashes on middle of dorsum of males; oviparæ dark olive-green, with anterior and posterior ends of body pale; legs and antennæ pale to brownish; cornicles brownish; wings hyaline; stigma pale, bordered with brown.

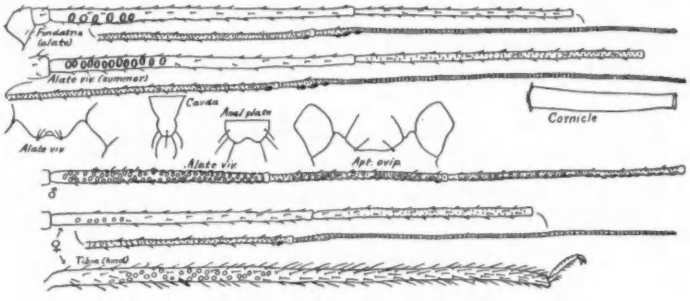

FIG. 81. *Drepanosiphum braggii.*

Measurements.—Alate summer vivipara.—Body 3 mm.; hind tibiæ 2.80 mm.; hind tarsi .19 mm.; antennæ 6.3 mm.; joint III 1.3 to 1.5 mm.; IV .93 to 1.05 mm.; V .95 to 1.10 mm.; VI .15 to .22 + 1.20 to 1.80 mm.; cornicles .60 to .80 mm. Apterous vivipara unknown.

Structural Characters.—Vertex slightly convex. Frontal tubercles strongly developed, diverging. Secondary sensoria, oval, transverse and ciliated, 6 to 13 in number on joint III of alate viviparæ; 4 to 8 on oviparæ; numerous on III, IV, and V of male. Cornicles cylindrical, somewhat constricted before flanges and gently curved outwards. Rostrum barely attaining third coxæ. Cauda knobbed. Anal plate indented. Hairs slightly capitate, short in alatæ, long in apteræ. Fundatrices and males alate. Oviparæ with terminal abdominal segments prolonged to form distinct ovipositor.

Collections.—On leaves of *Acer negundo.* Taken in the state at Fort Collins; fundatrices, May 15 to June 4; alate summer viviparæ, June 20 to Oct. 2; apterous oviparæ, Sept. 5 to Nov. 2; males, Sept. 3 to Oct. 3; quite common.

Subtribe **Chaitophorina.**

KEY TO GENERA OF CHAITOPHORINA.

A. Cauda knobbed.
B. Antennae 5-jointed. (Page 915) ..... **Sipha**
BB. Antennae 6-jointed. (Page 916) ..... **Chaitophorus**
AA. Cauda semi-lunar, broader than long. (Page 920) ..... **Periphyllus**

Genus **Sipha** Pass.

Type, *Aphis glyceriae* Kalt.* (Passerini, Gli Afidi, p. 29, 1860).

Characters.—Body flat and elongate, covered with long, stout spines. Frontal tubercles, lacking. Antennæ shorter than body; 5-jointed, bearing hairs not longer than diameter of joints bearing them. Secondary sensoria circular, large. Unguis at least as long as base of VI. Cornicles truncate, short, not longer than broad. Cauda knobbed. Anal plate rounded, often hidden by terminal segment of abdomen. Living on leaves of grasses in wet places.

Sipha agropyronensis (Gillette).

Gillette, Ent. News, Vol. 22, p. 442, 1911. *Chaitophorus.*

Color.—Alate viviparæ.—Black on thorax, green on abdomen, with faint dorsal dashes. Apteræ rusty-yellow with pair of darker longitudinal stripes; legs mostly pale.

Measurements.—Apterous summer vivipara.—Body 1.8 by .7 mm.; hind tibiæ .5 mm.; hind tarsi .15 mm.; antennæ .43 to .49 mm.; joint III .17 mm.; IV .07 mm.; V .08 + .06 mm.; cornicles .03 mm. long; cauda .06 mm. Alate vivipara.—Body 1.6 to 1.9 mm.; hind tibiæ .6 mm.; antennæ .65 mm.; joint III .28 mm.; IV .10 mm.; V .11 + .07 mm.; cornicles .04 mm.; cauda .05 mm.

*Not drawn on account of impossibility of obtaining authentic specimens or drawings to copy.

Structural Characters.—Secondary sensoria circular, large, 4 to 6 on joint III in alate viviparæ; absent in apteræ. Rostrum short, not attaining third pair of coxæ. Anal plate slightly emarginate. Body surface not spinose. Mediæ either once or twice branched. Other characters as described for genus.

Collections.—On upper surface of leaves of *Agropyron glaucum;* attended by small ants. Recorded in the state at Fort Collins, Boulder, and Denver; apterous summer viviparæ, May 26 to Sept. 18; alate viviparæ, May 31 and July 23; oviparæ, Oct. 13; 21 collections; fairly common.

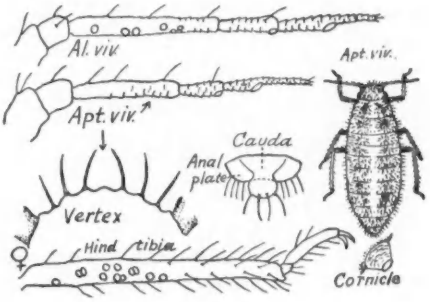

FIG. 82. *Sipha agropyronensis.*

Genus **Chaitophorus** Koch.

Type, *Aphis populi* Linn. (Koch, Die Pflanzenlause Aphiden, p. 1, 1854).

Characters.—Frontal tubercles, absent. Antennæ 6-jointed, with circular or oval sensoria and bearing prominent hairs; unguis twice or more times as long as base. Cornicles truncate, hardly longer than broad, reticulate, and imbricated. Cauda knobbed. Anal plate rounded or indented. Fore wings with mediæ twice branched. Males either apterous or alate.

Genotype, *Chaitophorus populi* (Linnaeus). (See below.)

KEY TO SPECIES OF CHAITOPHORUS.

A. Secondary sensoria on joint III, in alate viviparae, arranged in a single row, not more than 10 in number.
  B. Antennal joint IV hardly ever exceeding .15 mm. Sensoria on III in alate, 8 to 10. On *Salix.* (Page 919) ..... **viminalis**
  BB. Antennal joint IV about .20 mm. Sensoria 2 to 5. On *Populus.* (Page 917) ..... **populella**
AA. Secondary sensoria on joint III, in alate viviparae, arranged in irregular double row, 12 or more in number.
  B. Usually with sensoria on IV. (Page 918) ..... **populifoliae**
  BB. Without sensoria on IV. (Page 917) ..... **populi**

[Genotype **Chaitophorus populi** (Linnaeus).]

Linnaeus, Edition 10, Systema Naturae, p. 453, 1758. *Aphis.*

Color.—In viviparæ.—Yellowish-green to dark green or dusky; with darker mottling; alatæ with black bands; legs greenish or ochreous; cornicles green to smoky in apteræ, black in alatæ; cauda green or dusky.

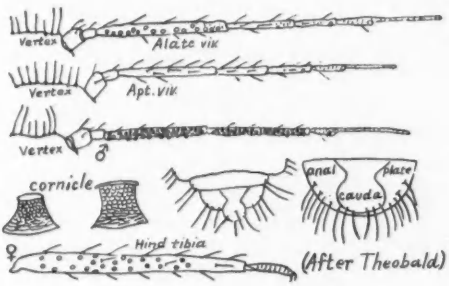

FIG. 83. *Chaitophorus populi.*

Measurements.—Apterous summer vivipara.—Body 2 to 2.5 mm. Cornicles as long as antennal joints I plus II. Antennæ shorter than body; IV a little longer than V; joint III about twice as long as IV; unguis two or three times base.

Structural Characters.—Secondary sensoria circular, scattered along almost entire joint III in alate viviparæ, 16 to 19 on III, 0 on IV; absent in apteræ. Cornicles truncate, expanded at base, reticulate distally, imbricated proximally. Hairs rather long on antennæ, longer on body. Rostrum attaining second or third coxæ. Cauda knobbed. Anal plate rounded. Males both alate and apterous.

Hosts.—Leaves of trees. (Data from description by Theobald in Aphid Gr. Brit., vol. 3, 1929).

Chaitophorus populella Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. of Amer., Vol. 21, p. 15, 1928.

Color.—Apterous summer vivipara.—Light green to yellowish with darker green circle on dorsum of abdomen connected by lines to lateral margins of abdominal segments 1, 2 and 7; faint, dusky bands on abdomen of alate viviparæ; wings hyaline; legs pale.

Measurements.—Apterous summer viviparæ.—Body 1.5 to 2 mm.; antennæ .95 to 1.4 mm.; III .30 to .44 mm.; IV .15 to .28 mm.; V .14 to .19 mm.; VI .10 + .20 to .30 mm. Alate vivipara.—Same as aptera.

Structural Characters.—Secondary sensoria 2 to 5 on joint III in alate viviparæ, none on IV or V; absent in apteræ. Cornicles truncate,

broader at base, faintly reticulate and imbricated. Cauda knobbed. Anal plate sinuate. Males both alate and apterous.

Collections.—On leaves of *Populus occidentalis, angustifolia* and sp. Recorded in the state at Fort Collins, Aspen, Eckert, and Steamboat Springs; fundatrices, March 30 and April 2; apterous viviparæ, April 20 to July 23; alate viviparæ, April 20 to July 20; sexuales, Oct. 10 to 23; 25 collections; fairly common.

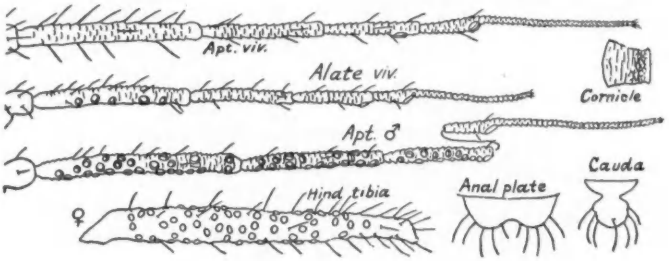

FIG. 84. *Chaitophorus populella.*

Taxonomy.—This species is distinguished from *Chaitophorus essigi* Gillette and Palmer (Syn. *Eichochaitophorus populifolii* Essig) in joint III being longer than spur; V, 1.5 to 2 times base of VI; spur, 2 to 3 times base of VI. Essig's species has spur longer than III or subequal, V not longer than base of VI and spur 3 to 4 times base of VI. From *Chaitophorus populifoliæ* Oestlund it differs by fewer secondary sensoria on III, in a single row, the absence of sensoria on IV, also the absence of dark bands on abdomen of alate viviparæ.

Chaitophorus populifoliae Oestlund.

Oestlund, "Aphididae of Minn." Geo. and Nat. Hist. Sur. Minn., p. 38, 1887.

Color.—Pale green, mottled with darker green in apteræ; with blackish bands on alatæ.

Measurements.—Alate vivipara.—Body 2 to 2.20 mm.; antennæ about 1.25 to 1.5 mm.; joint III .25 to .42 mm.; IV .17 to .23 mm.; V .13 to .18 mm.; VI .10 mm. + .20 to .35 mm. Apterous summer vivipara.—Same as alata, except spur generally shorter than III, but sometimes subequal.*

*Two collections were taken August 12 and 20 at Pingree Park and Black Mesa, in which the specimens had spur never shorter, usually longer than III and sensoria 6 to 10 in a row on antennal joint III in alate viviparae. These resemble *Chaitophorus essigi* Gillette and Palmer (Syn. *Eichochaitophorus populifolii* Essig) excepting in the dark bands of the alatae.

Structural Characters.—Secondary sensoria circular, 12 to 21 in number, irregularly arranged on joint III, 0 to 5 on IV in alate viviparæ; absent in apteræ. Hairs on antennæ rather short, .03 to .05 mm. long. Other characters same as *Chaitophorus populella* Gillette and Palmer.

FIG. 85. *Chaitophorus populifoliae.*

Collections.—On leaves and twigs of *Populus.* Recorded on *Populus tremuloides*, throughout the state; apterous summer viviparæ, June 13 to Oct. 2; alate viviparæ, June 22 to Sept, 25; sexuales, Oct. 2; 12 collections; rather common.

Chaitophorus viminalis Monell.

Monell, Bul. U. S. Geol. & Geog. Terr. Surv. V, No. 1, p. 31, 1879.

Color.—Apteræ.—Green, brown, or yellow, often with a pair of broad black vittæ extending laterally. Alatæ green with bands on all abdominal segments.

Measurements.—Apterous summer vivipara.—Body 1.5 to 2 mm.; antennæ about half as long as body; joint III .25 to .29 mm.; IV .11 to .16 mm.; V .09 to .13 mm.; VI .09 + .15 to .30 mm.

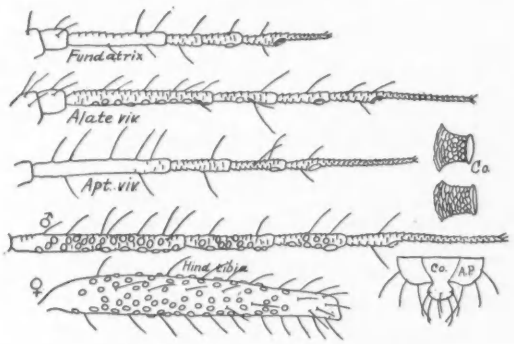

FIG. 86. *Chaitophorus viminalis.*

Structural Characters.—Secondary sensoria 8 to 10 on III in alate viviparæ, 0 to 2 or rarely 4 on IV, none on V. Hairs prominent and spine-like on antennæ and body. Cornicles reticulate, often indistinctly, on distal .6 or .75, remainder imbricated. Cauda knobbed. Anal plate sinuate. Males alate or apterous (?).

Collections.—On leaves of *Salix* sp. Recorded generally throughout the state; fundatrix, April 28; apterous summer viviparæ, May 21 to Oct. 20; alate viviparæ, May 29 to Oct. 20; oviparæ, Oct. 2 to Nov. 7; males, Oct. 2 to 22; numerous collections; very common.

Taxonomy.—This species is separated from *Chaitophorus nigræ* Oestlund, by the absence of sensoria on antennal joint V, 0 to 2, rarely 4, on IV, and rarely over 10 on III, while *nigræ* has 10 to 14 on III, 4 to 6 on IV, and 1 to 4 on V, in 10 examples kindly sent by Dr. Oestlund. Examples of *viminalis* sent by Monell agree with Colorado specimens. Apteræ of *nigræ* are more reticulate on dorsum than *viminalis*, but this is often difficult to discern.

[Genus **Periphyllus** Van der Hoeven.]

Type, *Periphyllus, testudo* Van der Hoeven, 1863 (=*testudinatus* Thornton, 1852). (Van der Hoeven, Tijd. voor. Ent., Vol. 6, p. 7, 1863).

Characters.—Frontal tubercles absent. Antennæ 6-jointed, except in dimorph, with circular to oval sensoria and prominent hairs; unguis, not shorter than base. Cornicles short, truncate, usually imbricated or reticulate. Cauda and anal plate, rounded. Fore wings with mediæ twice branched. Males alate or apterous.

Genotype, *Periphyllus testudinatus* (Thornt.). (See below.)

KEY TO SPECIES OF PERIPHYLLUS.

A. Unguis subequal with base of VI. On *Salix*.
  B. Length 2.50 to 3 mm. Never blackish. Veins not smoky. On bark near roots. (Page 925) ..... **salicicorticis**
  BB. Length 2 to 2.50 mm. Dark brown to blackish. Veins smoky. On bark of twigs. (Page 922) ..... **macrostachyae**
AA. Unguis longer than base of VI. Not on *Salix*.
  B. Hairs on vertex shorter than .10 mm. On *Populus*. (Page 924) .. **populicola**
  BB. Hairs on vertex longer than .10 mm. On *Acer*.
    C. Unguis longer than twice as long as base; hairs on antenna joint III as long as twice diameter of joint. On *Acer negundo*.
      D. Sensoria on III in alatae less than 15. (Page 923) ..... **negundinis**
      DD. Sensoria on III in alatae more than 15. (Page 920) .... **testudinatus**
    CC. Unguis less than twice as long as base. Hairs on antennal joint III, hardly as long as diameter of joint. On *Acer glabrum*. (Page 921), **brevispinosus**

[Genotype **Periphyllus testudinatus** (Thornt.).]

Thornton, Proc. Entom. Soc. London, n. s., (2), p. 78, 1852. *Phyllophorus*. Van derHoeven, Tidjscher, Ent. Ned, Ent. Ver., VI, pp. 1–7, 1863.

Color.—Dark green to gray.

Measurements.—Body 3 mm.; antennæ shorter than body; unguis 2 or 3 times as long as base but shorter than III.

Structural Characters.—Secondary sensoria circular, about 20, scattered along entire length of III in alatæ. Cornicles truncate, finely reticulate on slightly dilated base, which is imbricated or rugose.

Cauda half-moon shaped. Anal plate entire. Flabellate dimorphs produced, bearing six rows of dorsal plates. Flabellæ broadly rounded. Males alate.

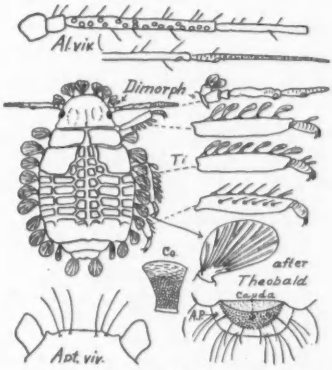

FIG. 87. *Periphyllus testudinatus.**

Host.—Leaves of *Acer*. (Description after Theobald in Aphid. Gr. Brit., Vol. 3, 1929.) Not recorded in the state.

Periphyllus brevispinosus Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. of Am., Vol. 23, p. 546, 1930.

Color.—Brown, with dark and light mottling in apteræ, and dusky bands in alatæ; cornicles yellow; legs mostly yellow; wings hyaline.

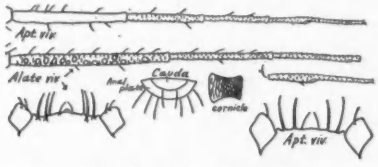

FIG. 88. *Periphyllus brevispinosus.*

Measurements.—Apterous summer vivipara.—Body 2.40 mm. by 1.50 mm.; hind tibiæ .85 mm.; antennæ 1.30 mm.; joint III .36 to .47 mm.; IV .22 to .30 mm.; V .20 to .23 mm.; VI .14 mm. + .18 to .20 mm.; cornicles .10 mm.; spines on body, .10 to .12 mm. Alate vivipara.—Length 2.25 mm.; hind tibiæ 1 mm.; antennæ 1.55 mm.; joint III .43 to .55 mm.; IV .28 to .40 mm.; V .25 to .30 mm.; VI .14 mm. + .17 to .22 mm.; cornicles .11 mm.; cauda .14 mm. Hairs on body and vertex spine-like, .13 mm. long and heavy; on antennæ, much finer, not over .04 mm. long.

*Hairs on antennae are erroneously drawn, only half as long as in Theobald's drawing.

Structural Characters.—Secondary sensoria circular to oval in irregular double row, 11 to 19 in number on III in alate viviparæ. Rostrum barely attaining second pair of coxæ. Mediæ twice branched. Cauda and anal plate rounded.

Collections.—On leaves of *Acer glabrum.* Recorded in the state at Idaho Springs; alate and apterous summer viviparæ, June 17, 1926; one collection; rare, but abundant on trees found infested.

Types in U. S. Nat. Mus., Cat. No. 42816; paratypes in collection of Colo. Agr. Exp. Sta.

Periphyllus macrostachyae (Fssig).

Essig, Pom. Coll. Jour. Ent. 4, p. 727, 1912. *Symydobius.*

Color.—Apterous vivipara.—Reddish-brown to blackish; alatæ with black bands, lighter area about cornicles; cornicles yellow. Fore wings, slightly smoky, veins narrowly bordered with brown, stigma short, with depression at distal end, with light streak extending from subcosta. Immature forms pale or reddish-yellow marked by reddish-brown as follows: band on first abdominal segment, a pair of dorso-lateral longitudinal lines from prothorax to fourth abdominal segment, and ring enclosing pale area around cornicles and connecting anteriorly with band on first abdominal segment; thus making pale "Y" pattern on dorsum, similar to *P. populicola.*

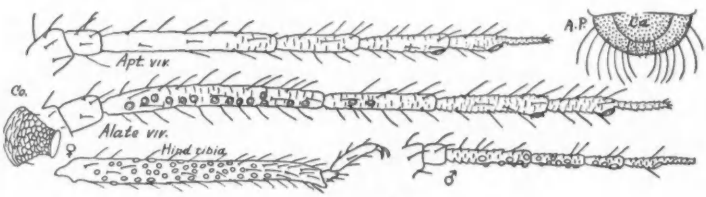

FIG. 89. *Periphyllus macrostachyae.*

Measurements.—Apterous summer vivipara.—Body 1.5 to 2 mm. by .8 to 1 mm.; hind tibiæ, .7 to .9 mm.; hind tarsi .14 mm.; antennæ .75 to 1 mm.; joint III .30 to .34 mm.; IV .15 mm.; V .13 to .17 mm.; VI .10 + .07 to .12 mm.; cornicles .06 to .07 mm.; cauda .05 mm. Alate vivipara.—Body 1.5 to 2.5 mm.; hind tibiæ 1 mm.; hind tarsi .16 mm.; antennæ .90 to 1.3 mm.; joint III .38 to .50 mm.; IV .17 to .23 mm.; V .15 to .22 mm.; VI .09 to .12 + .10 to .12 mm.; cornicles .07 mm.; cauda .05 mm.

Structural Characters.—Hairs on antennæ about 1.5 as long as diameter of joints bearing them. Secondary sensoria circular, with rims, arranged in single row along entire length of III, 9 to 14 in number, 1 to 3 on IV, and 0 to 1 on V in alatæ; absent in apteræ. Cornicles truncate, broader than long, with faint reticulations distally, imbricated and bearing 4 to 6 short hairs basally. Cauda semicircular. Anal

plate rounded. Hairs spine-like and heavy. Rostrum attaining between second and third coxæ. Males apterous.

Collections.—On bark of twigs of *Salix* sp. Recorded in the state at Fort Collins, Bellvue, Boulder, Rocky Ford, and Englewood; apterous viviparæ, May 2 to Aug. 21; alate viviparæ, May 9 to Aug. 21; oviparæ, Oct. 14 to 25; males, Oct. 14; 19 collections; rather common.

Taxonomy.—This form differs from *P. macrostachyæ* (Essig) according to the original description and two paratypes kindly sent by Professor Essig, in the shorter rostrum. As no other specific differences are apparent it seems best not to erect a new species at present.

Periphyllus negundinis (Thomas).

Thomas, Ill. State Lab. Nat. Hist. Bul. 2, p. 10, 1877. *Chaitophorus.*

Color.—In summer vivipara.—Yellowish or sap-green to apple-green; legs pale to dusky; cornicles pale; sexuales, olive-green to brownish.

Measurements.—Apterous summer vivipara.—Body 2 to 2.5 mm. by 1 mm.; hind tibiæ .70 to 1.1 mm.; hind tarsi .15 mm.; antennæ 1 to 1.5 mm.; joint III .23 to .44 mm.; IV .20 to .30 mm.; V .15 to .27 mm.; VI .08 to 12 + .20 to 34 mm.; cornicles .10 mm.; cauda .07 mm. Alate vivipara.—Same as aptera or slightly larger.

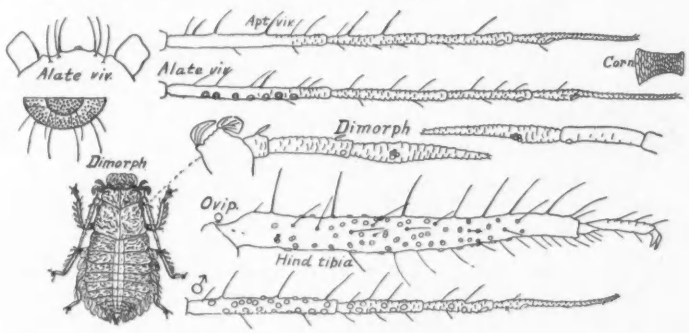

FIG. 90. *Periphyllus negundinis.*

Structural Characters.—Hairs spine-like, .12 to .16 mm. long on head, and .08 mm. on antennal joint III. Secondary sensoria circular with narrow rims, 3 to 9 in single row, along most of III in alate viviparæ; absent in apteræ. Cornicles truncate, slightly narrowed in middle, reticulate throughout. Cauda semicircular. Anal plate entire. Rostrum barely attaining second pair of coxæ. Dimorphs produced with flabellæ more or less pointed, and with only the median two rows of dorsal plates, remainder of dorsum rugose. Males apterous.

Collections.—On leaves and twigs of *Acer negundo.* Recorded in the state at Fort Collins, Meeker, Ridgway, Colorado Springs, and Ouray; fundatrices, March 12 to May 4; apterous summer viviparæ, May 10 to Oct. 31; alate viviparæ, May 4 to Sept. 27; oviparæ, Oct. 3 to Nov. 16; males, Oct. 3 to 15, dimorphs, May 4 to Aug. 19; 70 collections; very common.

Periphyllus populicola (Thos.).

Thomas, Ill. State Lab. Nat. Hist. Bul. 2, p. 10, 1877. *Chaitophorus.*

Color.—Head brown; body yellowish or greenish with dusky bands and lateral spots in alatæ; in apteræ rather solid mottling of brownish, leaving only a pale V-shaped area on dorsum, pale ring about cornicles and pale median area on terminal abdominal segments; cornicles pale. Fore wings with veins heavily bordered with smoky; hind wings with veins but faintly bordered; young rusty anteriorly and with median dorsal spot on abdomen, remainder of abdomen pale greenish-yellow with pale median "V" pattern on thorax.

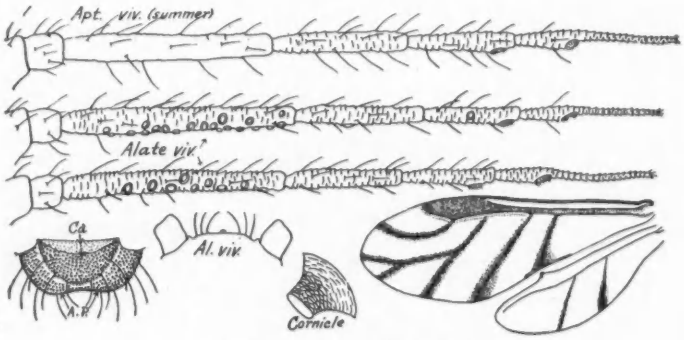

FIG. 91. *Periphyllus populicola.*

Measurements.—Apterous summer vivipara.—Body 2 to 2.5 mm.; hind tibiæ .9 to 1 mm.; hind tarsi .16 to .19 mm.; antennæ 1.3 mm.; joint III .30 to .39 mm.; IV .17 to .25 mm.; V .16 to .21 mm.; VI .10 to .13 + .17 to .20 mm.; cornicles .09 mm.; cauda .05 mm. Alate vivipara.—Same as aptera or with slightly longer appendages, especially antennal joint III.

Structural Characters.—Hairs on antennæ about as long as diameter of joint bearing them. Secondary sensoria circular, with narrow rims, 9 to 24 scattered along entire length of III, 0 to 6 on IV, 0 to 2 on V in alatæ; absent in apteræ. Cornicles truncate, short, dilated at base, imbricated, sometimes showing faint reticulation on distal half. Rostrum hardly attaining second pair of coxæ.

Collections.—On leaves and twigs of *Populus balsamifera, acuminata, occidentalis,* and *angustifolia.* Recorded throughout the state; fundatrices, April 30 to May 23; apterous viviparæ, May 7 to Oct. 23; alate viviparæ, May 29 to Oct. 20 (Dimorphs were received from the late Mr. Monell, taken at St. Louis, Mo., June 19, 1907); oviparæ, Oct. 2 to 31; alate males, Oct. 9 to 31; 85 collections; very common.

Taxonomy.—This species has been used as type of the genus *Neothomasia* Baker, but the writers do not consider the differences to be of generic importance.

Periphyllus populicoli var. **bruneri** (Williams).

Williams, "Aphididae of Nebraska," University Studies, Vol. 10, p. 25, 1911. *Chaitophorus.*

Characters.—Same as typical *P. populicola* excepting that the coloring is much darker. Apteræ polished dark-brown or black with segment lines pale and little or no trace of the pale "V" or "Y" pattern; legs black throughout. Alatæ with head and thorax dark-brown or black; abdomen, yellowish to brown, with dark bands. Cornicles pale in both forms. Foré wings with veins conspicuously bordered with blackish. Hind wings with media and cubitus faintly bordered. Immature forms more rusty-brown and showing the "Y" pattern.

Collections.—On leaves and twigs of *Populus tremuloides* rarely on *Populus balsamifera candicans.* Recorded in the state throughout the mountains wherever the host plant occurs; apterous viviparæ, June 21 to Sept. 2; alate viviparæ, June 21 to Aug. 25; 18 collections; common.

Periphyllus salicicorticis (Essig) (?).

Essig, Pom. Coll. Jour. Ent. 4, p. 731, 1912. *Symydobius.*

Color.—Dingy or greenish-yellow, or rusty-brown with darker dashes in alatæ; apteræ with dashes often broken but with light areas about cornicles; cornicles pale, veins of fore wing rather heavy and brown, but hardly smoky.

Measurements.—Apterous summer vivipara.—Body length 2.3 mm.; width 1.3 mm.; hind tibiæ .90 mm.; hind tarsi .14 mm.; antennæ 1 mm.; joint III .33 to .37 mm.; IV .14 mm.; V .14 mm.; VI .10 + .09 mm.; cornicles .07 mm.; cauda .07 mm. Alate vivipara.—Same as aptera or slightly larger.

Structural Characters.—Secondary sensoria 10 to 16 on III, 0 to 2 on IV in alatæ*; absent in apteræ. Cornicles truncate, broader at

*Three alate viviparae were taken on which the secondary sensoria were not evident on the antennae, but in all other characters they appear to agree with the other examples.

base, shorter than broad. Cauda semi-circular. Anal plate entire. Hairs moderately heavy, spine-like. Rostrum attaining first or second abdominal segment. Males apterous.

Collections.—On bark of *Salix* sp., at or beneath the surface of the ground. Recorded in the state at Fort Collins, Denver, Antonito, and Rocky Ford; fundatrices, May 2; apterous summer viviparæ July 1 to Sept. 23; alate viviparæ, May 28 and Aug. 11; oviparæ and males, Oct. 10 to 31; 14 collections; rather common.

Taxonomy.—This species is exceedingly difficult to separate from the form here determined as *P. macrostachyæ* (Essig). Indeed the lighter coloration and the habitat at the surface of the ground seem to be the only distinguishing characters. It seems likely that further biological study may prove both forms to belong to one species.

Subtribe **Fullawayina.**

Characters.—Frontal tubercles lacking. Antennæ conspicuously hairy. Cauda semi-lunar. Anal plate rounded. Cornicles lacking. Differing from *Chaitophorini* in the absence of cornicles.

Genus **Fullawaya** Essig.*

Type, *Fullawaya saliciradicis* Essig. (Essig, Pom. Coll. Jour. Ent., Vol. 4, p. 716, 1912).

Characters.—Frontal tubercles lacking. Ocular tubercles present. Lateral tubercles well developed. Body and all appendages conspicuously hairy. Cornicles lacking. Cauda semi-lunar, broader than long.

Genotype **Fullawaya saliciradicis** Essig.

Essig, Pom. Coll. Jour. Ent. 4, p. 737, 1912.

Color.—In all forms.—Yellowish-brown to brownish-yellow to blackish; finely pulverulent throughout; legs sordid yellow; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 2 to 3 mm.; hind tibiæ .12 to .17 mm.; hind tarsi .22 to .26 mm.; antennæ 1.6 to 2 mm.; joint III .42 to .48 mm.; IV .30 to .35 mm.; V .30 to .36 mm.; VI .20 to .24 + .32 to .35 mm. Alate vivipara.—Same as aptera.

*Borner (1930) considers that this genus should be *Pulvius* Sanborn (Kans. Univ. Bul., Apr., p. 225, 1906). The writers are unable to agree with this opinion. The eyes in Sanborn's species are rudimentary, consisting of but three ocelli and the rostrum is once and a half the length of the body. In *saliciradicis* Essig the eyes are normal and compound, and the rostrum is subequal with the body in length. It appears probable that Sanborn had immature forms (only 3 in ants' nest) and it is impossible to determine to which of several genera they may have belonged.

Structural Characters.—Hairs pointed, numerous; on antennæ .05 to .06 mm. long, about as long as diameter of joint bearing them; on vertex and body .08 to .10 mm.; on hind tibiæ .04 to .06, shorter than diameter of tibiæ. Secondary sensoria small, circular, arranged in an irregular row on joint III, 13 to 21 in alate viviparæ; 3 to 7 in apteræ. Lateral tubercles very large. Rostrum obtuse, about the same length as body. Mediæ twice branched. Other characters as given for genus.

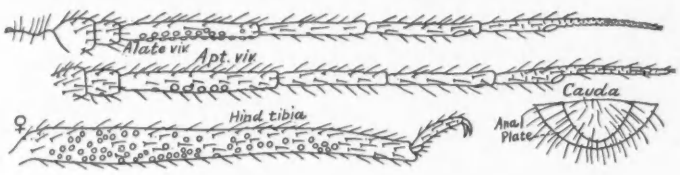

FIG. 92. *Fullawaya saliciradicis.*

Collections.—On roots of *Salix laevigata.* Recorded in the state at Fort Collins and Boulder; apterous summer viviparæ, June 4 to Sept. 24; alate viviparæ, June 10 to Sept. 7; oviparæ, Oct. 18 to Nov. 4; males, Oct. 18; 11 collections; rather rare.

Subtribe **Pterocommina.**

Characters.—Differs from *Chaitophorini* in longer cornicles, from *Lachnini* in shorter legs, pronounced lateral tubercles, and longer cornicles. Living on bark of trees.

KEY TO GENERA OF PTEROCOMMINA.

A. Cornicles cylindrical. (Page 927) ..... **Pterocomma**
AA. Cornicles swollen.
B. Cornicles with flange. (Page 931) ..... **Clavigerus**
BB. Cornicles without flange. (Page 929) ..... **Plocamaphis**

Genus **Pterocomma** Buckton.

Type, *Pterocomma pilosa* Buckton.* (Buckton, Monog. Br. Aphides, Vol. 2, p. 142, 1879).

Characters.—Cornicles cylindrical, with distinct flange. Antennæ shorter than body, bearing hairs which are pointed and longer than diameter of joints. Cauda semi-lunar. Anal plate entire. Body conspicuously hairy. Lateral tubercles well developed. Ocular tubercles present. Living on bark of *Salix* and *Populus.* Only two species recorded from the state.

KEY TO SPECIES OF PTEROCOMMA.

A. Unguis usually shorter than half of III. Cornicles cylindrical. (Page 928) ..... **populea**
AA. Unguis usually longer than half of III. Cornicles slightly swollen. (Page 928) ..... **beulahensis**

*Not figured on account of inability to obtain either authentic specimens or drawings.

Pterocomma beulahensis (Ckl.).

Cockerell, Can. Ent. XXXVI, p. 263, 1904. *Cladobius.*

Color.—In vivipara.—Yellowish-olive-green; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm.; hind tibiæ 1.9 to 2 mm.; hind tarsi .20 to .25 mm.; antennæ 1.9 to 2 mm.; joint III .50 to .65 mm.; IV .32 to .40 mm.; V .30 to .38 mm.; VI .15 to .20 + .30 to .35 mm.; cornicles .20 to .27 mm. Alate vivipara.—Same as aptera.

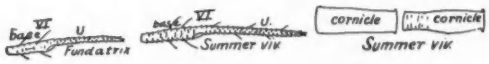

FIG. 93. *Ptercomma beulahensis.*

Collections.—On *Populus tremuloides*, on bark. Recorded in the state near Fort Collins, Pingree Park, Idaho Springs, and Lost Lake; fundatrices, June 11; apterous summer viviparæ, June 30 to July 5; alate viviparæ, June 22 to July 5; 6 collections; rather rare.

Taxonomy.—Differs from *P. populea* in longer unguis, usually over half length of III, 1.5 to twice base of VI, and 1.25 to 1.5 times cornicles; and in the cornicles, which though practically cylindrical in some views, appear slightly but distinctly swollen in other views. These differences would hardly seem sufficient to distinguish a separate species were it not for the difference in host plant.

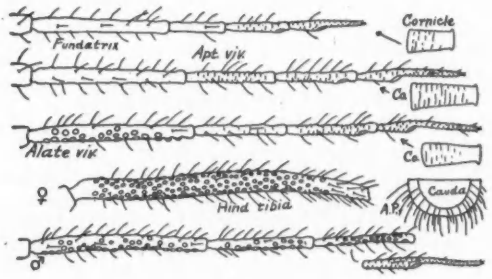

FIG. 94. *Ptercomma populea.*

Pterocomma populea (Kaltenbach).

Kaltenbach, Mon. der Pflanzenlause, p. 116, 1843. *Aphis.*

Color.—Yellowish-olive-brown, slightly pulverulent; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm.; hind tibiæ 1.2 to 1.8 mm.; hind tarsi .20 mm.; antennæ 1.2 to 1.7 mm.;

joint III .45 to .50 mm.; IV .24 to .27 mm.; V .21 to .27 mm.; VI .12 to .14 + .17 to .23 mm.; cornicles .20 to .24 mm. Alate vivipara.—Same as aptera or with slightly longer appendages.

Structural Characters.—Hairs pointed, numerous. Secondary sensoria 19 to 26 on joint III in alate viviparæ; 0 in apteræ. Rostrum attaining abdomen. Cornicles cylindrical, faintly rugose proximally. Males alate.

Collections.—On bark of *Populus balsamifera* in Colorado. Recorded at Fort Collins, Estes Park, and Longmont; fundatrices, April 19 to May 8; apterous summer viviparæ, May 30 to Oct. 25; alate viviparæ, May 6 to Oct. 10; oviparæ, Oct. 10 and Nov. 13; males, Sept. 18 (in Estes Park); 14 collections; fairly common.

Genus **Plocamaphis** Oestlund.*

Type, *Melanoxanthus flocculosus* Weed. (Oestlund, "A Synoptical Key to the Aphididae of Minn." 19th Rept. St. Ent. Minn., p. 122, 1922).

Characters.—Frontal tubercles lacking. Antennæ conspicuously hairy. Hairs pointed. Secondary sensoria circular; usually present in apteræ. Rostrum obtuse, terminal joint indeterminate. Cornicles longer than broad, swollen, with tip contracted, opening small and without flange. Cauda semi-lunar or triangular, broader than long. Anal plate entire. Body conspiculusly hairy, and flocculent. Lateral tubercles pronounced. Ocular tubercles, small. Living on bark of trees.

Genotype, *Plocamaphis flocculosa* (Weed). (See below.)

KEY TO SPECIES OF PLOCAMAPHIS.

A. Cornicles large, equaling hind tarsi in length. (Page 929) ..... **flocculosa**
AA. Cornicles minute, much shorter than hind tarsi. (Page 930) ..... **braggii**

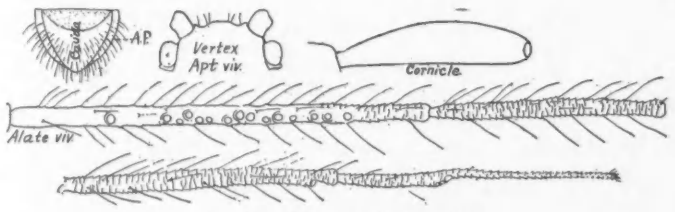

FIG. 95. *Plocamaphis flocculosa.*

Genotype **Plocamaphis flocculosa** (Weed).

Weed, Insect Life, III, p. 291, 1891. *Melanoxanthus.*

Color.—Dull yellowish-brown with a pair of longitudinal rows of black areas; very flocculent; cornicles bright orange; legs light brownish

*Takahashi (Pr. Ent. Soc. Wash., Vol. 32, p. 7, 1930) considers this genus as a synonym of *Clavigerus.*

to dusky. Wings hyaline, except cubital and anal veins on fore wings which are slightly smoky.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3.5 mm.; hind tibiæ 2 to 3 mm.; hind tarsi .30 to .35 mm.; antennæ 2.65 to 3 mm.; joint III .75 to 1.05 mm.; IV .50 to .60 mm.; V .50 to .63 mm.; VI .20 to .28 + .28 to .35 mm.; cornicles .35 to .40 mm. Alate vivipara.—Same as aptera, except cornicles .25 to .35 mm.

Structural Characters.—Hairs pointed, numerous, .08 to .10 mm. long; on antennæ twice as long as diameter of antennæ; on hind tibiæ about as long as diameter of tibiæ. Secondary sensoria circular, small, in apteræ usually 10 to 17, occasionally 0 on joint III; in alatæ 17 to 25 in irregular double row on III. Rostrum obtuse, attaining about to third coxæ. Cornicles smooth, swollen along entire length, contracted at both ends, held against body. Mediæ twice forked. Cauda triangular, bearing many hairs. Males apterous.

Collections.—On bark of *Salix*. Recorded in the state at Fort Collins and Eldora; fundatrices, April 16; apterous summer viviparæ, July 16 to Aug. 8; alate viviparæ, June 7 to Aug. 8; sexuales, Oct. 23; 7 collections; rare.

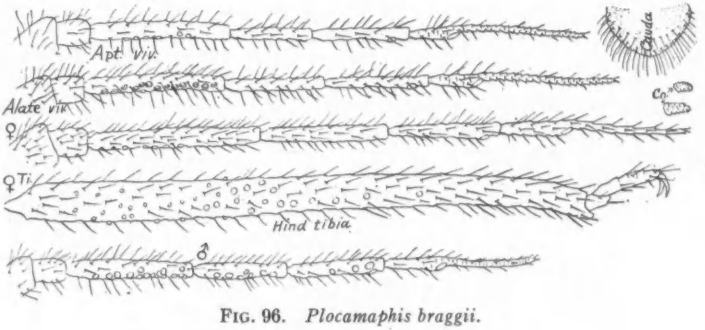

FIG. 96. *Plocamaphis braggii.*

Plocamaphis braggii Gillette and Palmer.

Gillette and Palmer, Ann. Ent. Soc. of Am., Vol. 22, p. 1, 1929.

Color.—In all forms.—Yellowish to dusky-brown, hairy; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 2.5 to 3 mm.; hind tibiæ 1.5 to 1.8 mm.; hind tarsi .20 mm.; antennæ 1.5 to 1.9 mm.; joint III .43 to .50 mm.; IV .25 to .32 mm.; V .29 to .33 mm.; VI .16 to .18 + .30 to .41 mm.; cornicles .05 to .06 mm.; cauda .15 mm.

Structural Characters.—Secondary sensoria small, with rims, and circular, 4 to 6 on III in apteræ, 10 to 14 in irregular row in alate viviparæ. Hairs pointed, numerous; on antennæ erect, .07 mm. long, slightly longer than diameter of antennal joints; on hind tibiæ about

same length, but slightly shorter than diameter of tibiæ; on body .08 to .10 mm. long. Lateral tubercles conspicuous on prothorax and all abdominal segments except the eighth. Ocular tubercles inconspicuous. Cornicles minute, difficult to discern, slender, cylindrical, hardly swollen, curved inward, without flange and constricted at opening, imbricated. Rostrum obtuse, attaining abdomen. Fore wings, with mediæ once branched in the 4 examples taken. Males apterous with numerous sensoria on joints III, IV, and V of antennæ.

Collections.—On roots of *Salix*. Recorded in the state at Fort Collins and Boulder; fundatrices, May 17; apterous summer viviparæ, Sept. 7 to 22; alate viviparæ, Sept. 7; oviparæ, Sept. 22 to Nov. 5; males, Oct. 18 to Nov. 5; 5 collections; rare.

Taxonomy.—This species resembles very closely *Fullawaya saliciradicis* Essig, but differs in the presence of minute cornicles.

Genus **Clavigerus** Szepligeti.*

Type, *Aphis salicis* Linnaeus. (Szepligeti, Rovaraszati Lapok I, p. 4, 1883).

Characters.—Body and appendages conspicuously hairy. Hairs, pointed. Lateral tubercles, well developed. Vertex, convex. Frontal tubercles lacking. Antennæ shorter than the body. Secondary sensoria circular or oval. Cornicles more or less swollen and with flange. Cauda semi-lunar, broader than long. Anal plate entire. Living on bark of trees.

Genotype, *Clavigerus salicis* (Linnaeus). (See below.)

KEY TO SPECIES OF CLAVIGERUS.

A. Cornicles much more than twice as long as wide; proximal fourth not swollen.
  B. Cornicles swollen at middle to twice diameter at base, bright orange in color. On *Salix*. (Page 931) ..... **salicis**
  BB. Cornicles swollen less than 1.5 times diameter at base.
    C. Unguis 1.6 to 2 times base of VI. On *Salix*. (Page 932) ..... **bicolor**
    CC. Unguis 1 to 1.5 times base of VI. On *Populus*. (Page 933) ... **populifoliae**
AA. Cornicles about twice as long as wide; swelling beginning at base. On *Populus* and *Salix*. (Page 934) ..... **smithiae**

Genotype **Clavigerus salicis** (Linnaeus).

Linnaeus, Edition 10, Systema Naturae, p. 453, 1758. *Aphis*.

Color.—In all forms.—Bluish to greenish-black with pattern of pulverulence on median and intersegmental lines and lateral and dorso-lateral areas; cornicles bright orange; legs brownish-yellow; wings hyaline; veins bordered with smoky.

*This is the genus generally known as *Melanoxantherium* Schouteden, 1901. *Clavigerus* was erected in 1883 by Szepligeti with type species "*Cl. salicis* Kaltenbach," which he mentions to be the same as *Aphis salicis* Linnaeus. (See Schumacher. Zoologischer Anzeiger, 1921 and 2).

Measurements.—Apterous summer vivipara.—Body 3.3 to 4 mm.; hind tibiæ 2.2 to 2.5 mm.; hind tarsi .25 mm.; antennæ 2 to 2.2 mm.; joint III .70 to .75 mm.; IV .40 to .50 mm.; V .35 to .38 mm.; VI .20 to .23 + .18 to .21 mm.; cornicles .50 to .55 mm. Alate vivipara.—Same as aptera.

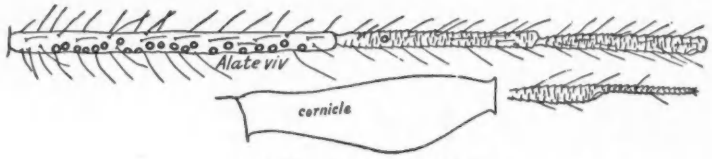

FIG. 97. *Clavigerus salicis.*

Structural Characters.—Hairs pointed, numerous; on vertex .10 to .11 mm.; on antennæ .07 to .10 mm., from once to twice as long as diameter of antennæ. Rostrum obtuse, attaining from second to third coxæ. Secondary sensoria small, circular, scattered in irregular double row along entire length of joint III, about 20 in number in alate viviparæ; 2 or 3 to 12 in apteræ. Cornicles smooth, much swollen distad of center, contracted just before flange, greatest diameter twice diameter at base. Fore wings with mediæ twice branched.

Collections.—On bark of *Salix* sp. Recorded in the state at Fort Collins, Boulder, Eldora, Colorado Springs, Log Cabin, and Gunnison; fundatrices, May 25 to 29; apterous summer viviparæ, May 28 to Oct. 16; alate viviparæ, May 28 to Aug. 6; sexuales, Oct. 16; 17 collections; hardly common.

FIG. 98. *Clavigerus bicolor.*

Clavigerus bicolor (Oestlund).

Oestlund, "Aphididae of Minn.," Geol. and Nat. Hist. Sur. Minn., p. 36, 1887. *Melanoxanthus.*

Color.—In all forms.—Reddish-brown to dusky greenish-yellow, with slight powdery markings on intersegmental lines; legs, cornicles and antennæ yellowish; young pale greenish; wings hyaline.

Measurements.—Apterous vivipara.—Body 3 to 4 mm.; hind tibiæ 1.5 to 2 mm.; hind tarsi .20 to .22 mm.; antennæ 1.5 to 2 mm.; joint III .40 to .50 mm.; IV .25 to .30 mm.; V .25 to .29 mm.; VI .12 to .18 + .24 to .30 mm.; cornicles .25 to .30 mm. Alate viviparæ.—Same as aptera or slightly longer.

Structural Characters.—Hairs numerous; on antennæ nearly erect, .07 to .08 mm. long, and 1.5 to 2 times as long as diameter of antennæ

on vertex .10 mm. long. Secondary sensoria circular, from 11 to 24 in irregular row on joint III in alate viviparæ; absent in apteræ. Cornicles 4 times as long as wide, somewhat swollen in distal half, very slightly imbricated, flange distinct. Rostrum obtuse, hardly attaining second coxæ. Lateral tubercles well developed. Mediæ twice forked. Males alate.

Collections.—On bark of *Salix* sp. Recorded in the state at Fort Collins, Greeley, Salida and Denver; fundatrices, April 2 to 18; alate and apterous summer viviparæ, April 2 to Nov. 6; sexuales, Oct. 2 to Nov. 10; 70 collections; extremely common and abundant.

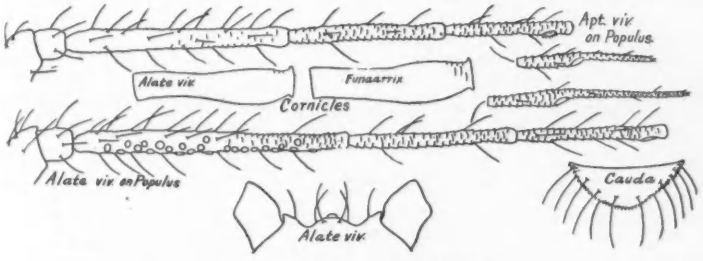

FIG. 99. *Clavigerus populifoliae.*

Clavigerus populifoliae (Fitch).

Fitch, Rept. Reg. Univ. State N. Y. Cab. Nat. Hist., p. 66, 1851. *Aphis.*

Color.—Same as in *Cl. bicolor.*

Measurements.—The only apparent difference seems to be in measurements of antennal joints. The fundatrices of the two forms appear to be indistinguishable. Apterous summer vivipara.—Antennal joint III .60 to .68 mm.; IV .35 to .40 mm.; V .33 to .37 mm.; VI .18 to .22 + .26 to .32 mm.; cornicles .33 to .40 mm.; hind tarsi .20 to .24 mm. Alate vivipara.—Same as aptera. All other characters appear to be as in *Cl. bicolor.*

Collections.—On bark of *Populus* sp. Recorded in the state at Fort Collins; fundatrices, April 18; apterous summer viviparæ, April 28 to June 8; alate viviparæ, May 8 to June 8 and Oct. 10; oviparæ, Oct. 27.

Taxonomy.—The forms here determined as *Clavigerus bicolor* and *populifoliæ* are very closely related and really rank intermediate between *bicolor* Oestlund and *populifoliæ* Fitch, according to Baker's measurements of unguis (Can. Ent. Vol. 48, p. 284, 1916). The unguis in summer viviparæ hardly

ever attains twice and sometimes hardly more than once and a half times base of VI in Colorado examples from *Salix*, and varies from once to once and a half times base in Colorado examples from *Populus*, but is subequal with base in fundatrices of both forms. There is sufficient overlapping so that no distinct line can be drawn and very few reach the extremes given by Baker for the two species. Possibly these forms are but variations of a single species. At present it seems best to determine the *Salix* form as *Cl. bicolor*, and the *Populus* form as *Cl. populifoliæ* until biological tests succeed in settling either the identity or the separate status of these forms.

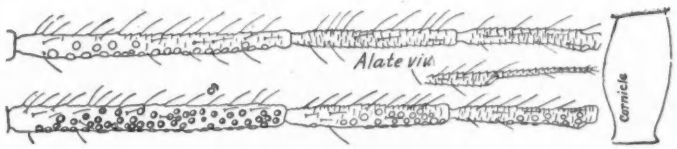

FIG. 100. *Clavigerus smithiae.*

Clavigerus smithiae (Monell).

Monell, Bul. U. S. Geol. & Geog. Surv. Terr. V, No. 1, p. 32, 1879. *Chaitophorus.*

Color.—All forms.—Dark brown, with slight powder which gives a bluish effect, legs, antennæ, and cornicles yellow-ochre; wings hyaline.

Measurements.—Apterous summer vivipara.—Body 3 to 4 mm.; hind tibiæ 1.8 to 1.9 mm.; hind tarsi .22 mm.; antennæ 1.5 to 1.7 mm.; joint III .48 to .53 mm.; IV .18 to .27 mm.; V .21 to .28 mm.; VI .13 + .17 to .18 mm.; cornicles .25 to .30 mm. Alate vivipara.—Same as aptera, or sometimes with antennal joints slightly longer.

Structural Characters.—Hairs numerous; on antennæ about twice as long as diameter of antennæ. Secondary sensoria small, circular, 20 to 24 in number scattered over entire length of joint III in alate viviparæ; absent in apteræ. Cornicles about twice as long as wide, swollen except at the two ends and with distinct flange. Media twice forked. Lateral tubercles well developed. Rostrum obtuse, attaining between second and third coxæ. Males alate.

Collections.—On bark of twigs of *Salix* and *Populus* sp. Recorded generally throughout the state; fundatrices, April 1 to 29; apterous summer viviparæ, May 5 to Oct. 25; alate viviparæ, May 6 to Oct. 27; oviparæ, Oct. 2 to Nov. 14; males, Oct. 1 to Nov. 3; 54 collections; very common.

SYNONYMICAL NOTES ON MEMBRACIDÆ. II.

FREDERIC W. GODING,
Livermore Falls, Maine.

Owing to the incomplete and occasionally misleading published descriptions of some of Walker's species of the Membracidæ, writers have not been unanimous in their opinions as to the modern genera in which such species belong. His two species of *Centrotus fasciatus* (List Hom. B. M., p. 1147 and id. Suppl., p. 161), *Centrotus opponans* (id. p. 160), *Centrotus oppugnans* (id. p. 160), and *Centrotus humilis* (id. p. 161), were unknown except *C. opponans* which Fowler identified as belonging to the genus *Tolania*. In the description of each species Walker referred to "the hind part" of the pronotum which has been interpreted as referring to the posterior process, whereas it is now known (thanks to Mr. China) that he referred to the scutellum except in one species.

Upon request, Mr. C. E. China kindly examined Walker's types in the British Museum and reports that the type of the *Centrotus fasciatus* first described could not be found, although judging from the description it belongs to the same group, while the types of *C. opponans*, *C. humilis*, and *C. fasciatus* of the Supplement all are destitute of a posterior pronotal process, the tegmina have seven apical cells, the apex of the clavus is acute, and the wings have four apical cells; hence, they belong to *Tolania*. As Walker used the name *fasciatus* for two species in the same genus, *Tolania walkeri* is proposed for the form described in the List Hom. Brit. Mus., Suppl. p. 161.

Mr. China states that the type of *Centrotus oppugnans* is furnished with a posterior pronotal process, the tegmina have five apical cells, the apex of the clavus is acute, and the wings have four apical cells, which characters exclude it from *Tolania*. A comparison of Walker's description and Mr. China's excellent figure of the type (Fig. 1) with Fowler's description of his genus *Centruchoides* and his figure of *C. laticornis* (Fig. 3) leaves no doubt that the two species are congeneric.

From a comparison of the description and figure of Amyot and Serville's lost *Ledra perdita* (Fig. 2) with the descriptions and figures of the two species of *Centruchoides*, it is evident that it also belongs to that genus. It is to be hoped that this study satisfactorily clears up the identity of *perdita*.

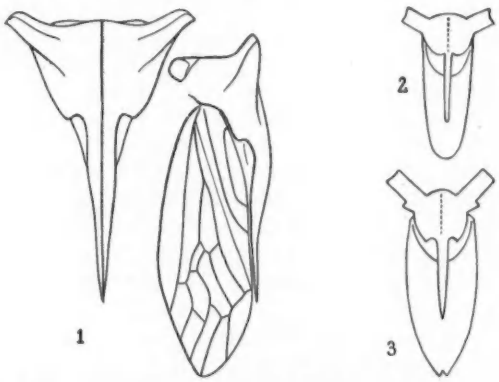

Fig. 1. *Centruchoides oppugnans* Walker, (China, del.).
Fig. 2. *Centruchoides perdita* Amyot and Serville (copied from A. & S.).
Fig. 3. *Centruchoides laticornis* Fowler (copied from Fowler).

A critical review of the genus *Phaulocentrus* Fowler proves it to be distinct from *Microcentrus* Stal, after excluding *P. cornutus* Fowler, which appears to be a true Microcentrus.

On page 92 of the Journal of the New York Entomological Society, Vol. XXXVIII, (1930), *Xiphidia* was described as a new genus. As that name was used in the Diptera by Dallas in 1869, and hence preoccupied, *Xiphistoides* is substituted for it.

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MAILING DATES FOR 1931 VOLUME OF ANNALS.

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December Number—December 19, 1931.